



Review

Level of Physical Activity in Pregnant Populations from Different Geographic Regions: A Systematic Review

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Abstract: The aim of this study was to examine the level of physical activity during pregnancy in different populations worldwide. An intensive search was carried out from February until May 2021. The inclusion criteria were original studies of healthy pregnant women, and the main study variable was the assessment of physical activity. A total of 110 out of 1451 studies were assessed for inclusion, using the Newcastle–Ottawa Scale for quality, and for the risk of bias. The 44 analyzed articles were divided into 5 tables according to the characteristics of the intervention and the validated instrument used to measure physical activity (PA). A total of 59.09% of the studies indicated that participants had a low level of physical activity during pregnancy. In addition, the median quality score of the studies was 7.12, and 77.27% of the studies were cataloged as having a high-quality score. Although international guidelines recommend that women without a contraindication engage in prenatal physical activity, the results of the present study show that the level of PA is too low for women to achieve scientifically proven maternal-fetal benefits. Failure to achieve the recommended levels of weekly physical activity could pose significant risks to maternal well-being.

Keywords: pregnancy; physical activity; health promotion; active; prevalence



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1. Introduction

Today's society shows concerning and increasing levels of physical inactivity, which are associated with an alarming number of complications and associated pathologies, such as gestational diabetes or preeclampsia [1,2]. In parallel, people are experiencing higher levels of stress in the body and more health problems year after year, which support the appearance of diseases that reduce the quality of life [3,4] as well as high globalized economic costs; these diseases are directly responsible for the high cost of medicines, hospital stays and clinical consultations [5].

The gestational period is not excluded from this problem [6], which supports the appearance of diseases. A relevant consequence is the saturation of the health system with complications and pathologies that could be addressed with healthy lifestyle habits, good nutrition, and the regular practice of physical activity [7].

It should be added that pregnancy is considered a period with great influence on the establishment of certain healthy habits that the woman will continue (in some cases throughout her life) [8]; therefore, comprehensive wellness interventions are necessary. Balance in pregnant women's systems is important to avoid maternal, fetal and newborn risks and ensure a healthy pregnancy. In this sense, physical inactivity can be a threat to this desired and complex situation [9], and therefore, it would be interesting to know the level of compliance to physical activity guidelines affecting the health of the mother and fetus [10]. Pregnant women spent more than 50% of their time in sedentary behaviors and it impacted on pregnancy outcomes for both mother (higher levels of C Reactive Protein or LDL Cholesterol) and child (larger newborn abdominal circumference or macrosomic infants) [11].

Increasingly, in recent years, the World Health Organization has been working on the creation of guidelines and recommendations for the practice of physical activity in the fight against high levels of sedentarism [12], and specifically, there are global organizations that, for more than 30 years, have been dealing with the complex relationship between physical activity and pregnancy for healthy pregnant women, publishing international clinical guidelines for physical exercise and pregnancy [13,14]. Specifically, recent universal guidelines (American, Canadian, Spanish), in consensus with others throughout the world, have established the recommendation for a healthy pregnant woman to stay physically active, performing 150 min of moderate physical activity at least 3 days a week and, whenever possible, under the supervision of a professional [13–15]. At this point, the current scientific consensus emerging from early evidence [16,17] suggests that an accumulation of 30 min or more of moderate exercise per day should occur on most, if not all, days of the week in the absence of either medical or obstetric complications, similar to the recommendation for the non-pregnant population.

In a global analysis, the scientific literature has confirmed a positive association between the regular practice of moderate physical activity by healthy pregnant women and maternal, fetal and newborn well-being [18]. Similarly, and in direct relation to the health of the mother and her future child, scientific evidence speculates that an active pregnancy produces an epigenetic effect of physical activity as a promoter of a healthy and balanced intrauterine environment as the basis of health, both during the gestational period and after it [19,20]. Accordingly, the objective of the present study was to examine the level of physical activity of the pregnant population in different regions of the world through the analysis of the scientific literature on this issue to be aware of the basis for future interventions.

2. Materials and Methods

This was a systematic review designed based on the Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines (P.R.I.S.M.A.) [21]. The protocol was registered in the International Prospective Register of Systematic Reviews (PROSPERO) (CRD42021262193).

2.1. Data Sources

An intensive search was carried out in the following databases: PubMed, Scopus, Sport Discus and Web of Science. The search began in February 2021 and ended in April 2021. To guarantee equality in the selection process, the same article selection criteria were used for all databases considering the differences in controlled vocabulary and syntax rules. The detailed search strategy is presented in Supplementary Material.

The reference lists of the selected studies were reviewed to identify other studies that may have been missed in the electronic keyword search. The registries' observational studies were reviewed to identify unpublished research. The search terms used were:

- (“physical activity” OR “exercise” OR “training”)
- (“barriers” OR “enablers” OR “access”)
- (“pregnancy” OR “maternal” OR “antenatal” OR “pregnant”)
- (“health” OR “wellbeing”)
- (“maternal outcome” OR “pregnancy outcome”)
- (“observational” OR “cohort” OR “qualitative” NOT “randomized clinical trial” NOT “RCT”)

2.2. Study Inclusion and Exclusion Criteria

To address the main objective, study inclusion and exclusion criteria were structured using the PICOS framework (population, intervention, comparison, outcome, study design) as a worksheet [22] (Table 1).

Table 1. PICOS framework.

PICOS	DEFINITIONS
Population	Healthy pregnant women.
Interventions	PA assessment carried out during pregnancy.
Comparison	Baseline data based on not practicing physical activity.
Outcome	The main variable of the study should record the PA developed during pregnancy.
Study design	Observational studies.

- **Population:**

The population of interest was healthy pregnant women without contraindications to physical exercise, regardless of their gestational age at the time of entry to the study. The characteristics of the population were reviewed in the methodology of each study. Women with contraindications were excluded from the analyses [13–15].

- **Intervention:**

The investigated intervention was related to the different forms of assessment, analysis and recording of the prevalence of physical activity during pregnancy in different regions of the world. Due to the different nature of the studies and, therefore, their different forms of interventions, studies whose measurement of physical activity was assessed through validated questionnaires, including the Pregnancy Physical Activity Questionnaire (PPAQ) [23], the International Physical Activity Questionnaire (IPAQ) [24], and the Kaiser Modified Questionnaire (KPAS) [25], or by direct and mixed measurements (accelerometer and pedometer) [26,27] were included (Table 2).

- **Comparison:**

In this case, the comparison was based on not practicing physical activity. For this comparison, women who engaged in physical activity were compared to those who did not.

- **Outcome:**

The primary outcome was the level of physical activity performed during pregnancy, and the secondary outcomes were variables corresponding to the mother and the newborn (Tables 3–7). The studies must have contained at least one primary study variable that somehow recorded the quantity of physical activity performed during pregnancy using the aforementioned validated questionnaires or direct measurement methods.

- **Study selection:**

In all cases, observational studies were selected, and studies related to interventions (randomized clinical trials or quasi-randomized clinical trials), some type of review (narrative, systematic or systematic review with meta-analysis) and qualitative research were excluded. In addition, articles published between 2006 and 2021 and written in English, Spanish and Portuguese were considered for the search.

2.3. Data Extraction

The selection process that was followed for the reviewed articles is captured in Figure 1 [28]. Titles and abstracts identified in the electronic searches were independently screened by two researchers to select potentially relevant studies. The abstracts were identified and passed an initial analysis, and posteriori searches of the full text were performed. The full texts were analyzed separately to search for priority outcomes for data extraction. Reference lists of selected articles were checked to identify possible additional studies not identified by electronic searches.

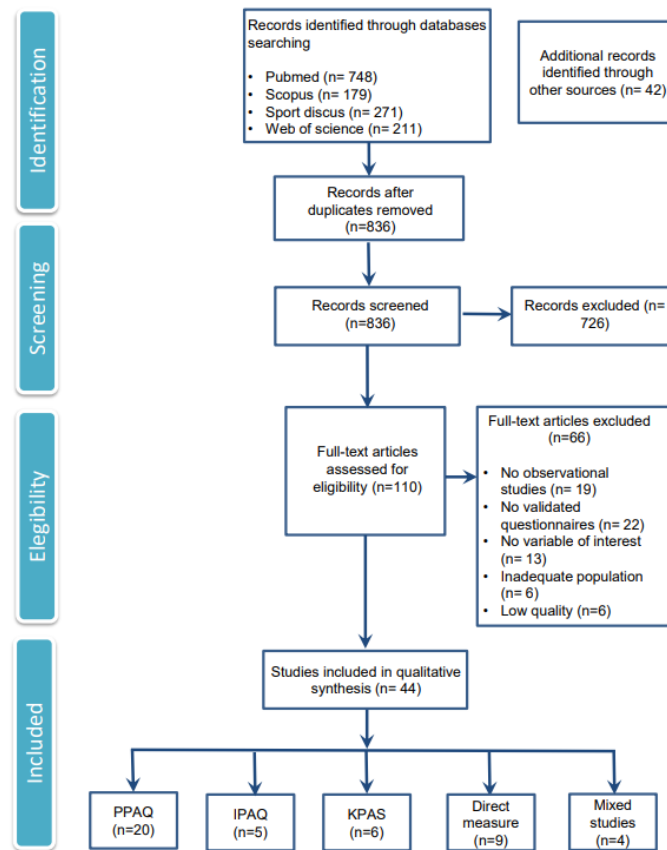


Figure 1. Flow chart of the results in each of the study development phases.

For studies where one of the investigators recommended their exclusion, both investigators agreed by consensus to make a final decision on whether they were included. In situations of absolute discrepancy, a third researcher provided his assessment on the inclusion of the study.

Finally, 110 studies from a total of 1451 studies were assessed for inclusion by two independent reviewers. Quality assessment and risk of bias were assessed following the Newcastle–Ottawa Scale (NOS), and studies classified as high or moderate quality were included [29,30]. This scale establishes an overall quality score that ranges from 0 to 9 stars using three factors in its measurement: selection, comparability, and results. A “high” quality score required 3 or 4 stars for selection, 1 or 2 stars for comparability, and 2 or 3 stars for results, and a “moderate” quality score required 2 stars for selection, 1 or 2 stars for comparability, and 2 or 3 stars for results [31]. Studies with lower scores were discarded.

2.4. Data Synthesis

Given our goal of knowing the levels of physical activity of the pregnant population in the existing literature, the heterogeneity in the study designs and in the techniques assessed and the measurement tools for the main variable, a narrative synthesis was carried out precluding the conduct of a formal meta-analysis. The 44 analyzed articles were divided into 5 tables according to the characteristics of the intervention and the instrument used to measure physical activity.

As shown in Tables 3–7, the data extracted from each study were divided into three groups. First, the data on the author(s), type of study, sample size, year of publication and country where the study was carried out were used to determine the methodological design. Then, data from the study group, such as gestational period, and maternal outcomes were used to define the characteristics of the sample. Finally, the physical activity measuring instrument, definition of physical activity and main conclusions were used to determine the method of measuring the primary outcome variable of the study.

Table 2. NOS quality score.

Studies		Selection			Comparability		Exposure		Total Quality Score	
Author, Year	Representativeness of the Exposed Cohort	Selection of the Non-Exposed Cohort	Ascertainment of Exposure	Demonstration That Outcome of Interest was not Present at Start of Study	Comparability of Cohorts on the Basis of the Design or Analysis	Ascertainment of Outcome	Was Follow-Up Long Enough for Outcomes to Occur	Adequacy of Follow Up of Cohorts		
	Aburezq 2020 [32]	1	1	1	1	1	1	0	7	
	Antosiak-Cyrak 2019 [33]	0	0	1	1	2	1	1	7	
	Chasan-Taber 2015 [34]	1	1	1	1	2	1	1	9	
	Chasan-Taber 2014 [35]	1	1	1	1	1	1	1	8	
	Davoud 2020 [36]	1	0	1	1	2	0	1	7	
	Gebregziabher 2019 [37]	0	1	1	1	2	1	0	7	
	Hailemariam 2020 [38]	1	1	0	1	2	1	0	7	
	Harrold 2014 [39]	1	0	1	1	2	0	1	7	
Record of Physical Activity using PPAQ	Ko 2016 [40]	0	1	0	1	1	0	1	5	
	Lee 2016 [41]	1	0	1	1	2	0	0	6	
	Lynch 2012 [42]	0	1	1	1	2	0	1	6	
	Mourady 2013 [43]	1	1	1	1	2	1	1	9	
	Okafor 2020 [44]	1	1	1	1	2	0	1	8	
	Santos 2016 [45]	1	1	1	1	1	1	1	8	
	Schmidt 2017 [46]	1	0	1	1	1	1	1	7	
	Todorovic 2020 [47]	0	1	1	1	2	1	1	8	
	Van der Waerden 2019 [48]	1	1	1	1	2	1	1	0	8
	Xiang 2019 [49]	0	1	0	1	2	1	1	1	7
	Yin 2019 [50]	0	1	1	1	1	1	1	1	7
	Zhang 2014 [51]	0	1	1	1	1	1	1	1	7
	Record of Physical Activity using IPAQ	Bertolotto 2010 [52]	0	1	1	1	1	0	1	0
Harizopoulou 2010 [53]		0	1	1	1	2	1	1	0	7
Padmapriya 2015 [54]		0	1	1	1	2	1	1	1	8
Régo 2017 [55]		1	1	1	1	1	1	1	1	8
Román-Gálvez 2021 [56]		1	1	0	1	2	0	1	1	7
Record of Physical Activity using KPAS	Bacchi 2016 [57]	0	1	1	1	2	0	1	1	7
	Chasan-Taber 2007 [58]	0	1	0	1	2	1	1	0	6
	Chasan-Taber 2008 [59]	0	1	1	1	2	1	1	1	8
	Currie 2014 [60]	0	1	1	1	2	0	1	1	7
	Fell 2009 [61]	1	1	0	1	1	1	1	1	7
	Fortner 2011 [62]	0	1	1	1	1	0	1	1	6

Table 2. Cont.

Studies		Selection			Comparability		Exposure		Total Quality Score
Author, Year	Representativeness of the Exposed Cohort	Selection of the Non-Exposed Cohort	Ascertainment of Exposure	Demonstration That Outcome of Interest was not Present at Start of Study	Comparability of Cohorts on the Basis of the Design or Analysis	Ascertainment of Outcome	Was Follow-Up Long Enough for Outcomes to Occur	Adequacy of Follow Up of Cohorts	
Direct measurements of physical activity	Di Fabio 2015 [63]	0	1	1	1	1	1	1	7
	Downs 2009 [64]	0	1	1	1	1	1	0	6
	Everson 2011 [65]	1	1	1	1	2	1	1	9
	Hawkins 2014 [66]	1	1	1	1	2	0	1	8
	Jiang 2012 [67]	1	1	1	1	2	0	1	7
	Morgan 2014 [68]	0	1	1	1	2	1	1	8
	Morkrid 2014 [69]	1	1	1	1	1	0	1	7
	Rousham 2006 [70]	1	1	1	1	1	1	1	8
Sinclair 2019 [71]	1	1	1	1	2	0	1	8	
Direct and indirect measurements with mixed studies of physical activity	Chadonnet 2012 [72]	0	1	1	1	1	0	1	6
	Cohen 2013 [73]	0	1	1	1	2	0	1	7
	Kominiarek 2018 [74]	0	1	1	1	1	0	0	5
	Medek 2016 [75]	0	1	1	1	1	0	1	6

Table 3. Record of Physical Activity using the PPAQ questionnaire during pregnancy.

	Author, Year, Country	Type of Study	N	Sample	GEST. AGE	INST.	PA REG.	Main Conclusion	Other Variables
[32]	Aburezq 2020 Kuwait	Cross-sectional study	653	Pregnant women from Kuwait	3T: >32 wk	PPAQ	MET h /wk	PA helps control weight, gestational blood pressure, and birth weight. Vigorous PA is more common in women without GDM	Sociodemographic, anthropometric, and pregnancy variables
[33]	Antosiak-Cyrak 2019 Poland	Observational study	267	Polish pregnant women	1T: 9 wk 2T: 21 wk 3T: 33 wk	PPAQ	MET h/wk	Women prefer low to moderate intensity exercises. Women with previous children perform more PA.	Sociodemographic and pregnancy variables
[34]	Chasan-Taber 2014 USA	Prospective cohort study	1276	Hispanic pregnant women	1T: 12 wk 2T: 21 wk 3T: 30 wk	PPAQ	MET h/wk	Women who meet PA guidelines have a lower and controlled GWG	Sociodemographic, behavioral, psychosocial and pregnancy variables
[35]	Chasan-Taber 2015 USA	Prospective cohort study	1240	Hispanic pregnant women	12.4 wk	PPAQ	MET h/wk	PA performed before and early in pregnancy does not significantly reduce the risk of GH	Sociodemographic, behavioral, psychosocial and pregnancy variables
[36]	Davoud 2020 Iran	Cross-sectional study	256	Iranian pregnant women	1T: <13 wk 2T:14–27 wk 3T: >28 wk	PPAQ	MET min/day	PA decreases during 2T and 3T. PA is related to quality of life	Sociodemographic, psychosocial and pregnancy variables
[37]	Gebregziabher 2019 Ethiopia	Cross-sectional study	458	Ethiopian pregnant women	ND	PPAQ	MET h/sem	Non-primiparous women with a higher level of education perform more PA	Sociodemographic and pregnancy variables
[38]	Hailemariam 2020 Ethiopia	Cross-sectional study	299	Ethiopian pregnant women	1T: <13 wk 2T:14–27 wk 3T: >28 wk	PPAQ	MET h/wk	Women with a lower academic level and who work at home are at greater risk of being sedentary	Sociodemographic and pregnancy variables.
[39]	Harrod 2014 USA	Longitudinal cohort study	826	Pregnant women	17 wk 27 wk 1 day postpartum	PPAQ	MET h/wk	Higher PA and total energy expenditure in the last stage of pregnancy are related to lower neonatal adiposity.	Sociodemographic, pregnancy and anthropometric variables of mother and newborn.
[40]	Ko 2016 China	Prospective descriptive study	150	Chinese pregnant women	29 wk 40 wk	PPAQ	MET h/wk	PA is higher in 2T and 3T. Women with low levels of PA have a greater chance of caesarean delivery	Sociodemographic, behavioral and anthropometric variables
[41]	Lee 2016 Taiwan	Cross-sectional study	581	Taiwanese pregnant women	1T: 14–16 wk 2T: 24–28 wk 3T: 30–32 wk	PPAQ	MET h/day	Higher energy expenditure in sports activities during 3T.	Sociodemographic and anthropometric variables

Table 3. *Cont.*

	Author, Year, Country	Type of Study	N	Sample	GEST. AGE	INST.	PA REG.	Main Conclusion	Other Variables
[42]	Lynch 2012 USA	Prospective cohort study	1355	Hispanic pregnant women	1T: 14–16 wk 2T: 24–28 wk 3T: 30–32 wk	PPAQ	MET h/wk	The predominant energy expenditure is that of domestic and care activities. Multiparous women who underwent pre-pregnancy PA are less likely to be inactive.	Sociodemographic, psychosocial and behavioral variables
[43]	Mourady 2017 Lebanon	Cross-sectional study	141	Lebanese pregnant women	1T: 14–16 wk 2T: 24–28 wk 3T: 30–32 wk	PPAQ	MET h/wk	Light PA is positively correlated with psychological health and social relationships.	Sociodemographic, psychosocial, anthropometric behavioral and pregnancy variables
[44]	Okafor 2020 South Africa	Cross-sectional study	1082	South African pregnant women	ND	PPAQ	MET h/day	Younger women perform less PA. Single and unemployed women are less active.	Sociodemographic, behavioral anthropometric variables
[45]	Santos 2016 Portugal	Longitudinal prospective study	118	Portuguese pregnant women	1T: <12 wk 2T: 12–28 wk 3T: >28 wk	PPAQ	MET h/wk	AF decreases significantly to a greater extent in 1T.	Sociodemographic and anthropometric variables
[46]	Schmidt 2017 Germany	Observational study	83	German pregnant women	1T: 14–16 wk 2T: 24–28 wk 3T: 30–32 wk	PPAQ	MET h/wk	PA decreases during pregnancy despite showing the availability of the necessary information for it.	Sociodemographic, behavioral anthropometric and pregnancy variables
[47]	Todorovic 2020 Serbia	Cross-sectional study	162	Serbian pregnant women	12 wk	PPAQ	MET min/wk	One third of women have insufficient PA in 3T. Lower PA is associated with a lower educational level.	Sociodemographic, behavioral and anthropometric variables
[48]	Van der Waerden 2019 France	2 cohort studies ELFE EDEN	575 1745	French pregnant women	3T <24–28 wk	PPAQ	MET h/wk	Less PA and sedentary lifestyle seems to be associated with postpartum depression.	Sociodemographic, psychosocial and pregnancy variables.
[49]	Xiang 2019 China	Cross-sectional study	1077	Chinese pregnant women	1T: <13 wk 2T: 13–28 wk 3T: >28 wk	PPAQ	MET h/wk	A high level of PA predominates, but not PE. Unemployed women without PA habits are more likely to fail to comply with PA guidelines, especially in 3T.	Sociodemographic, behavioral, anthropometric and pregnancy variables.
[50]	Yin 2019 China	Cross-sectional study	1179	Chinese pregnant women	1T: <12 wk 2T: 24–28 k 3T: >32 wk	PPAQ	MET h/wk	During pregnancy, an inactive lifestyle predominates, with low intensity unit exercises.	Sociodemographic, behavioral and anthropometric variables
[51]	Zhang 2014 China	Cross-sectional study	1056	Chinese pregnant women	1T: <13 wk 2T: 14–27 wk 3T: >28 wk	PPAQ	MET h/day	Women with a lower pre-pregnancy BMI, higher educational level and active husbands are more likely to perform PA and PE during pregnancy.	Sociodemographic, anthropometric and pregnancy variables

N.: sample size. GEST. AGE.: gestational age. INST.: instrument for measuring physical activity. PA REG.: record of physical activity. T.: trimester. WK.: week. H.: hour. MET.: metabolic equivalent of task. MIN.: minutes. PA.: physical activity. GDM.: gestational diabetes mellitus. GWG.: gestational weigh gain. GH.: gestational hypertension. PE.: physical exercise. BMI.: body mass index.

Table 4. Record of Physical Activity using the IPAQ questionnaire during pregnancy.

	Author, Year, Country	Type of Study	N	Sample	GEST. AGE	INST.	PA REG.	Main Conclusion	Other Variables
[52]	Bertolotto 2010 Italy	Observational study	268	Italian pregnant women	27 + 6 wk	IPAQ	MET min/wk	PA before pregnancy can lower the risk of GDM.	Sociodemographic, behavioral, anthropometric and pregnancy variables
[53]	Harizopoulou 2010 Greece	Cross-sectional study	160	Pregnant women	12 wk	IPAQ	MET min/wk	Physical inactivity before and during early pregnancy is associated with an increased risk of developing GDM	Sociodemographic, anthropometric, pregnancy, childbirth and newborn variables.
[54]	Padmapriya 2015 Singapore	Cohort study	1247	Chinese, Malarian and Indian pregnant women	26–28 wk	IPAQ	MET min/wk	The time spent on light, moderate and vigorous PA was reduced during pregnancy.	Sociodemographic, psychosocial, anthropometric and pregnancy variables
[55]	Rêgo 2017 Brazil	Cohort study	1447	Nulliparous pregnant women	25–26 wk	IPAQ	MET min/wk	No association was found between the level of PA in the 2T and 3T with adverse perinatal outcomes.	Sociodemographic, pregnancy and delivery variables
[56]	Román-Gálvez 2021 Spain	Prospective cohort study	463	Healthy pregnant women	1T: <14 wk 2T: 24 wk 3T: >32 wk	IPAQ	MET min/wk	Two-thirds of women achieve enough PA. Energy expenditure decreases throughout pregnancy.	Sociodemographic, behavioral anthropometric and pregnancy variables.

N.: sample size. **GEST. AGE.:** gestational age. **INST.:** instrument for measuring physical activity. **PA REG.:** record of physical activity. **T.:** trimester. **WK.:** week. **H.:** hour. **MET.:** metabolic equivalent of task. **MIN.:** minutes. **PA.:** physical activity. **GDM.:** gestational diabetes mellitus. **GWG.:** gestational weigh gain. **GH.:** gestational hypertension. **PE.:** physical exercise. **BMI.:** body mass index.

Table 5. Record of Physical Activity using the KPAS questionnaire during pregnancy.

Author, Year, Country	Type of Study	N	Sample	GEST. AGE	INST.	PA REG.	Main Conclusion	Other Variables
[57] Bacchi 2016 Italy	Longitudinal descriptive study	236	Caucasian pregnant women	1T: 14–16 wk 2T: 24–28 wk 3T: 30–32 wk	Modified Kaiser Questionnaire KPAS	Activity frequency	PA is generally low. In women with normal weight it increases in the 2T and 3T but in overweight women it remains stable.	Sociodemographic, behavioral anthropometric and pregnancy variables.
[58] Chasan-Taber 2007 USA	Prospective study	1231	Latina pregnant women	15 wk 28 wk	Modified Kaiser Questionnaire KPAS	Activity frequency	Occupational PA is higher in women with a high academic level and higher income. Domestic PA is higher in multiparous and older women.	Sociodemographic, behavioral, anthropometric variables
[59] Chasan-Taber 2008 USA	Prospective cohort study	1006	Hispanic pregnant women	>24 wk	Modified Kaiser Questionnaire KPAS	Activity frequency	A significant reduction in the risk of GDM is found in women who undergo some type of PA.	Sociodemographic, behavioral, anthropometric and pregnancy variables
[60] Currie 2014 Canada	Prospective cohort study	1749	Canadian pregnant women	20 wk	Modified Kaiser Questionnaire KPAS	Activity frequency	PA together with an active lifestyle is associated with a lower appearance of fetal macrosomia.	Sociodemographic, behavioral anthropometric variables, pregnancy and newborn.
[61] Fell 2009 Canada	Prospective cohort study	1737	Canadian pregnant women	21+4 wk	Modified Kaiser Questionnaire KPAS	Activity frequency	PA during the first 20 weeks of gestation is lower than pre-pregnancy PA.	Sociodemographic, behavioral, anthropometric variables.
[62] Fortner 2011 USA	Prospective cohort study	1043	Puerto Rican pregnant women	15+5 wk	Modified Kaiser Questionnaire KPAS	Activity frequency	Recreational PA in early pregnancy reduces the risk of GH.	Sociodemographic, anthropometric, psychosocial and pregnancy variables.

N.: sample size. **GEST. AGE.:** gestational age. **INST.:** instrument for measuring physical activity. **PA REG.:** record of physical activity. **T.:** trimester. **WK.:** week. **H.:** hour. **MET.:** metabolic equivalent of task. **MIN.:** minutes. **PA.:** physical activity. **GDM.:** gestational diabetes mellitus. **GWG.:** gestational weigh gain. **GH.:** gestational hypertension. **PE.:** physical exercise. **BMI.:** body mass index.

Table 6. Direct measurements of physical activity during pregnancy.

Author, Year, Country	Type of Study	N	Sample	GEST. AGE	INST.	PA REG.	Main Conclusion	Other Variables
[63] Di Fabio 2015 USA	Longitudinal prospective study	46	American pregnant women	18 wk 35 wk	Accelerometer	Min/day in activity intensity	Total PA is higher in women who met recommendations for pre-pregnancy PA.	Sociodemographic and anthropometric variables
[64] Downs 2009 Canada	Cohort study	80	Pregnant women	20 wk 32 wk	Pedometer	Steps/day	Women’s PA behaviors decreased from the second to third trimesters of pregnancy	Sociodemographic and anthropometric variables
[65] Everson 2011 USA	Cross-sectional study	359	American pregnant women	20–22 wk	Accelerometer	Min/day in activity intensity	Moderate/vigorous PA is higher in 1T and 2T compared to 3T.	Sociodemographic, psychosocial and pregnancy variables.
[66] Hawkins 2014 USA	Cross-sectional study	294	Healthy pregnant women	1T: <14 wk 2T: 24 wk 3T: >32 wk	Accelerometer	Min/day in activity intensity	Light PA has a protective effect on CRP in 2T.	Anthropometric and pregnancy sociodemographic variables.
[67] Jiang 2012 China	Cohort study	919	Healthy pregnant women	18–28 wk 29–35 wk	Pedometer	Steps/day	50% of women in 2T and 60% in 3T had low levels of PA.	Sociodemographic and anthropometric variables
[68] Morgan 2014 United Kingdom	Prospective cohort study	466	Healthy pregnant women	ND	Accelerometer	Min/day in activity intensity	A reduced PA is associated with instrumental deliveries. Being overweight and obese is related to pregnancy and childbirth problems.	Sociodemographic, anthropometric, pregnancy and delivery variables.
[69] Morkrid 2014 Norway	Cohort study	759	Healthy pregnant women	15 wk	Accelerometer	Min/day in activity intensity	Higher level of PA in early pregnancy reduces the risk of GDM development.	Sociodemographic, anthropometric and pregnancy variables.
[70] Rousham 2006 United Kingdom	Prospective cohort study	57	Pregnant women	wk: 12 16 25 34 38	Accelerometer	Min/day in activity intensity	PA levels are reduced during pregnancy.	Sociodemographic variables
[71] Sinclair 2019 Canada	Cohort study	70	Canadian pregnant women	1T: 16–18 wk 2T: 24–26 wk 3T: 32–34 k	Accelerometer	Min/day in activity intensity	A higher level of sedentary lifestyle is associated with a higher level of perceived stress.	Sociodemographic variables

N.: sample size. **GEST. AGE.:** gestational age. **INST.:** instrument for measuring physical activity. **PA REG.:** record of physical activity. **T.:** trimester. **WK.:** week. **H.:** hour. **MET.:** metabolic equivalent of task. **MIN.:** minutes. **PA.:** physical activity. **GDM.:** gestational diabetes mellitus. **GWG.:** gestational weigh gain. **GH.:** gestational hypertension. **PE.:** physical exercise. **BMI.:** body mass index.

Table 7. Direct and indirect measurements with mixed studies of physical activity during pregnancy.

Author, Year, Country	Type of Study	N	Sample	GEST. AGE	INST.	PA REG.	Main Conclusion	Other Variables
[72] Chandonnet 2012 Canada	Cross-sectional study	49	Canadian pregnant women with obesity	1T: 13 wk 2T: 25 wk 3T: 35 wk	PPAQ Accelerometer	MET h/wk Min/day in activity intensity	PA is reduced during pregnancy. The highest energy expenditure occurs in housework and sedentary activities.	Sociodemographic, behavioral and anthropometric variables.
[73] Cohen 2013 Canada	Observational study	54	Canadian pregnant women	26 wk	PPAQ Pedometer	MET h/day Steps/day	Women with a goal to perform PA are more likely to meet the guidelines.	Sociodemographic, anthropometric and pregnancy variables.
[74] Kominiarek 2018 USA	Observational study	49	Hispanic and american pregnant women	28 wk 36 wk	PPAQ Accelerometer	MET h/wk MET min/day Steps/day	PA is reduced and sedentary activity increases as the pregnancy progresses.	Sociodemographic, behavioral and anthropometric variables.
[75] Medek 2016 Iceland	Observational study	217	Icelandic pregnant women	24- 28 wk	IPAQ Pedodometer	MET min/wk Steps/day	Vigorous PA appears to be beneficial to maternal glucose tolerance, both in BMI and overweight and obese women.	Sociodemographic, behavioral and pregnancy variables.

N.: sample size. **GEST. AGE.:** gestational age. **INST.:** instrument for measuring physical activity. **PA REG.:** record of physical activity. **T.:** trimester. **WK.:** week. **H.:** hour. **MET.:** metabolic equivalent of task. **MIN.:** minutes. **PA.:** physical activity. **GDM.:** gestational diabetes mellitus. **GWG.:** gestational weigh gain. **GH.:** gestational hypertension. **PE.:** physical exercise. **BMI.:** body mass index.

3. Results

The flow chart shows the results obtained in relation to each of the study development phases: identification, exploration, eligibility, and inclusion. Of a total of 1451 studies that were identified, 836 were screened, and 110 of them were full text assessed for eligibility. A total of 44 studies [32–75] were finally analyzed and included for synthesis.

3.1. Quality Assessments

The quality assessments of the included studies are summarized in Table 2. The median quality score of the studies was 7.12 (range 5 to 9) after removing low-quality studies. With this assessment, 22.73% of the studies were rated as moderate quality (n = 10) [40–42,52,58,62,64,72,74,75], and 77.27% were rated as high quality (n = 34)[32–39,43–51,53–57,59–61,63,65–71,73].

In detail, when analyzing the selection quality factors, 52.27% of the studies[33,37,40,42,47,49–54,57–60,62–64,68,72–75] had flaws in the representativeness of the exposed cohort due to the calculation of the sample size being unusual. In terms of comparability, all studies displayed at least one control factor for the comparability of the cohorts based on the design or analysis. Finally, in relation to the evaluation of the quality of the results, 40.90% of the studies [36,39–42,44,52,56,57,60,62,66,67,69,71–75] lacked evidence in the control of the factor or ascertainment of the outcome.

3.2. Characteristics of the Included Studies

In a global perspective, 44.44% of the studies (n = 12) [33,37,38,42,44,47,49,51,56–58,64] reported, as a primary result, that PA levels were directly and positively related to maternal educational level, and the remaining 55.56% [32,34–36,39–41,43,45,46,48,50,52–55,59–63,65–75] showed, on one hand, the relationship of PA levels with other maternal factors; on the other hand, they focused on describing the practice of PA during pregnancy. PA carried out during this period is recorded as mostly in domestic activities [41,42,58,72].

In general, the analyzed studies covered two types of studies with different themes: on one hand, 61.36% (n = 27) [33,34,36–38,41,42,44–47,49–51,54,56–58,61,63–65,67,70,72–74] showed the descriptors of patterns and habits of physical activity during pregnancy, and on the other hand, 38.64% (n = 17) [32,35,39,40,43,48,52,53,55,59,60,62,66,68,69,71,75] showed the effect of a physically active lifestyle during the nine months of gestation on different maternal-fetal parameters. Over half of the articles (59.09%) (n = 26) [33,34,36–38,41,42,44–47,49–51,54,57,58,61,63–65,67,70,72–74] found levels below what is indicated in the international recommendations, namely 150 min per week of moderate PA.

Only one article found that two-thirds of the sample met the recommendations [56]. The remaining 17 articles also found inadequate PA levels associated with pregnancy problems (gestational hypertension, diabetes, depression, anxiety, or fetal macrosomia). Low to moderate intensity of gestational PA was registered more frequently than the vigorous one [33,43,50,66], without the weekly exercise being sufficient to meet the international standards.

The gestational period in which the information was collected in the studies is diverse, as is the methodology for describing it. Articles that compared physical activity during the three trimesters of pregnancy stand out [33,36,38,39,41–43,45,46,49–51,56,57,66,70–72], indicating the gestational weeks in which the data were collected. The other group of articles [32–35,40,43–45,58–67,69,73–75] collected data on PA performed in the first weeks of pregnancy (>15 weeks) middle of pregnancy (20–24 weeks) or at the end of pregnancy (>26 weeks) in a specific way. Physical activity decreases throughout pregnancy compared to pre-gestational PA [46,47,50,54]. Specifically, low and inadequate PA was found during the first trimester [60,61,70] and there was a progressive decrease from the second to the third trimester [36,49,56,64,65,67,72,74]. In contrast, 2 articles found a higher PA, without being enough, during the last trimester of pregnancy [40,45].

The included studies were found in a total of 22 countries and relate to a large sample of pregnant women (n = 28,728). Specifically, the largest number of studies have been carried

out in Asia (10) [32,36,40,41,43,49–51,54,67], North Europe (n = 7) [33,46,48,68–70,75], South Europe (n = 6) [45,47,52,53,56,57], North America (n = 17) [34,35,39,42,58–66,71–74], Africa (n = 3) [37,38,44] and South America (n = 1) [55].

Asian countries find lower levels of PA during pregnancy and a progressive decrease in it, with the exception of the study by Ko (2016) [40]. The physical measurement study stands out, finding that 50% during the 2nd trimester and 60% during the third trimester do not reach the suggested recommendations.

As for the European continent, a decrease in the PA level during pregnancy is reflected both for the countries of North and South Europe. A lower PA is associated with mental [48] and physical [68] problems, as well as evidence for both the northern region [69] and the southern region [52,53] that PA from early pregnancy prevents complications, such as gestational diabetes. Specifically, it is recorded in South Europe that two thirds of the pregnant population do not reach the optimal energy expenditure during pregnancy [56].

In studies conducted in the North American area, PA generally decreases and sedentary lifestyle increases during pregnancy; however, a difference is visible between behavioral self-report studies that find lower PA in the first trimester [61], and studies with direct physical measurements [64,65], which record lower levels as gestation progresses. Similarly, it is found that performing PA only at the beginning of pregnancy lacks benefits [35]. Nevertheless, performing PA from the beginning and continuing throughout the pregnancy prevents complications such as gestational diabetes [34,59] or gestational hypertension. [62], as in European countries.

Studies conducted in Africa mainly associate the practice of PA with educational level and multiparity, with educated women and those with previous children being the most active [37,38,44]. Finally, the only study found in South America [55] shows no association between PA and perineal outcomes.

The study designs that are presented varied in their nomenclature, with 43.18% of the studies (n = 19) defined as cohort studies [34,35,39,42,48,54–56,58–62,64,67–71] and 34.09% defined as cross-sectional studies (n = 15) [32,36–38,40,43,44,47,49–51,53,65,66,72]. The remaining studies have been classified by their authors as observational [33,46,52,73–75] and prospective longitudinal [45,57,62]. Cohort studies base the selection of the cohort on the specific population of the corresponding regions.

Related to pregnancy outcomes, maternal variables that were collected were divided into sociodemographic (age, academic level, purchasing power, job occupation, marital status, parity or previous miscarriages) anthropometric (prepregnancy BMI, prenatal weight gain, height, waist, hip circumference, maternal BMI at delivery), psychosocial and behavioral (sleep habits, food intake, smoking or alcoholism), pregnancy (parity, ethnicity, age, education level, marriage, smoking previously and during pregnancy, employment status, household income, weight gain, skinfolds, body circumferences, chronic disease history, gestational diabetes, blood pressure, gestational hypertension, preeclampsia), perinatal (gestational age at delivery, birth <37 weeks, type of delivery, duration or injuries) and newborn (perinatal mortality, birth weight (<2500g, 2500–4000g, >4000g), body fat mass, Apgar 1, Apgar 5, length or head circumference) data. Studies found that performing PA helps control gestational weight gain [32], reduced risk of gestational diabetes [34,52,53,59,69] and gestational hypertension [62], lessened c-sections [40] and instrumental delivery [68], lower neonatal adiposity [39] and macrosomia [60] and stress [71] during pregnancy and lessened postpartum depression [48].

In addition, it is relevant to show that 13 studies [34–36,42–44,48,51,56,62,67,69,71] administered other questionnaires on nutrition, sleep or depression to address and fully explore the complexity of the multifactorial course of pregnancy.

Research studies were divided into three different groups: studies with indirect methods which use validated questionnaires for data recording, studies with direct methods using on-site technological material to take measurements and mixed studies with direct and indirect methods of physical activity quantification. The data collection has been

similar in all the studies analysed, since it is given by the scientifically validated protocol of each instrument used.

3.2.1. Studies with Indirect Methods of Physical Activity Quantification

Regarding the data collection instruments, within the indirect measurements, the use of the “Pregnancy Physical Activity Questionnaire” (PPAQ) was predominant, as a validated and reference questionnaire among the pregnant population (Table 3), followed by the “International Physical Activity Questionnaire” IPAQ (Table 4) and the “Modified Kaiser Questionnaire” KPAS (Table 5). These questionnaires are reliable and validated in pregnant women and provide information on the time spent on activities in the life of pregnant women, including items on family, work, or sports/exercise.

The main difference found in the collection of information resides in the fact that the PPAQ records of PA use METS hours/week, the IPAQ uses METS minutes/week and the KPAS has its own measurement on a Likert-type scale, making it difficult to compare the quantitative results among them. Furthermore, among the studies that used the PPAQ as a measurement instrument, 5 collected PA in METS hours/day, making extrapolation of the results even more difficult.

3.2.2. Studies with Direct Methods of Physical Activity Quantification

The main instruments for the objective measurement of PA during pregnancy that are reflected in the scientific literature are the use of accelerometers and pedometers, with 7 and 2 articles in each case, respectively (Table 6). The measurement system for the accelerometer is the min/day that are invested for each activity and for the pedometers, the amount of steps/day. In addition, a wide heterogeneity was observed in the duration of data collection, ranging between 3 and 7 consecutive days of recording the activity with these devices in the studies.

3.2.3. Mixed Studies with Direct and Indirect Methods for Quantifying Physical Activity

Publications that used both (4 studies) both direct and indirect measures focused on a more complete view of PA patterns and combined the two reference questionnaires (PPAQ and IPAQ) with objective data from accelerometers and pedometers (Table 7). The data collection system was identical to what was stated in the previous sections.

4. Discussion

This study aimed to examine the level of PA in pregnant populations from different regions of the world. When attempting a global analysis of the different studies, one of the main questions from a scientific point of view is the diversity found in the way of measuring the gestational PA as seen in the included tables. It is interesting to note that many of these studies, in addition to the assessment of the PA, combined the analysis of certain maternal-fetal parameters, which provides us with an additional analysis to consider. Regarding the division by geographical regions, despite finding differences in the study modalities and associations between registered variables, possibly due to the type of research that has been performed and the economic resources to carry it out, low patterns of PA are widely found.

In this sense, it can be observed that the studies that use direct measures of physical activity using technological elements are carried out in high-income countries, mainly in North America [63–66,71] and North Europe [68–70]. However, the compatibility of the results can become complex due to variations in the methodology, registration, and data processing [76] so the conclusions should be interpreted with caution. In contrast, studies conducted in the African [37,38,44] or South American [55] regions using self-report questionnaires associate this physical activity with maternal educational levels and parity, showing a great intrinsic social problem in these geographical areas. However, the quantity and quality of studies in low-income countries is scarce, so the use of a specific methodology

to study the prevalence of PA and the increase in socioeconomic resources to obtain data that can be extrapolated worldwide is vital.

Similarly, previous studies with general populations, show a deep variation in trends in inactivity across regions, income groups, and countries [77]. Higher rates of insufficient physical activity have been recorded in high-income countries while East and Southeast Asia maintain better physical levels [77]. In contrast, women and populations with limited economic resources tend to be less physically active than those with greater resources [78] so this trend could be similar with the pregnant population.

In addition to the cultural paradigm associated with each geographical region, it is worrying that approximately 40% of the female population meets the minimum recommendations for weekly PA [79], evidencing as a latent problem among the population of reproductive age. Added to this is that, currently during the COVID-19 pandemic, the lowest PA levels are more frequent in women, being a potential risk group for physical inactivity [80] during all stages of life, especially during pregnancy.

It is clearly essential to educate women that physical activity promotes improved cardiovascular function, decreased risk of gestational diabetes mellitus, hypertension, and a lower percentage of body fat in the mother, increased gestational age, and improved neurodevelopment in the child [81]. Thus, a recommendation for PA with early onset and throughout pregnancy may be key to improving maternal-fetal parameters [34,35,59,62].

From a methodological point of view, the studies reviewed have great variation as to when they evaluated PA during the pregnancy which makes it difficult to compare across studies and represents an important future research topic. This problem was exposed in the study by Chan (2019) on regulated PA programs where inconsistencies in findings hamper the drawing of firm conclusions [82]. Therefore, an important scientific challenge exists in this area, needing future research.

As stated, the analysis of each of the aforementioned tables offers us different ways of studying and recording gestational PA, which at the same time causes significant confusion and makes data generalization impossible. However, in each of the cases, it can be verified that pregnancy is a period with a certain decrease, in some cases, the total absence, of a regular practice of physical activity. Although the recommendations were not followed, the realization of the minimum level of physical activity during pregnancy is supported by most of the articles reviewed and is in agreement with other previous studies [83,84].

At a general level, the results obtained show that, in most populations studied, PA levels do not reach universal basic recommendations to achieve the already proven benefits of physical practice in maternal, fetal, and newborn outcomes. This has been previously exposed by Borondulin and colleagues (2008) who showed that only a small proportion of pregnant women reached the recommended level of PA [85], and by Lindqvist and colleagues (2016) who found that less than half of the sample met the guidelines [86]. Likewise, scientific studies with the adult population find that less than 10% of adults perform 150 min per week of moderate PA [87]. Specifically in pregnant women, it has been observed that, maintaining levels of light physical activity can promote wellbeing [88] as well as controlling the presence of gestational diabetes, even when starting from a lower intensity physical activity measured with accelerometry [89]. However, previous studies with direct measurements of quality accelerometry in this population are limited and the studies analyzed do not provide generalized conclusions.

In the same way, it was observed that higher levels of physical practice are associated with higher socioeconomic and cultural conditions, and many of the studies that were analyzed remind us of the positive effects of moderate physical practice on maternal parameters, not only of a physical or physiological nature but also psychological and emotional. This has been demonstrated by studies on this subject [90–92]. Together, these results show the need to establish a minimum guideline of moderate PA during pregnancy as a basic and fundamental element for the health of future populations.

Even when a more detailed analysis was carried out and attention was focused on the European population, studies developed in Germany [46], Spain [56], France [48], Greece [53],

Italy [52,57], Iceland [75], Norway [69], Portugal [45], the United Kingdom [68–70], Serbia [47] and Poland [33] clearly and specifically show this decrease in PA in the gestational period. Some of these studies also reaffirmed the beneficial effects mentioned previously that are associated with a more active pregnancy.

Beyond the European analysis, in our opinion, the excellent study carried out by Evenson and Wen in 2011 [65] with 359 pregnant American women aged ≥ 16 years, who wore an accelerometer for 1 week, is remarkable. This study described the prevalence and correlations between physical activity and sedentary behaviors measured among these pregnant women. For this, in addition to the accelerometer, cross-sectional data collected from the United States National Health and Nutrition Survey (NHANES) from 2003 to 2006 were used. The authors found that most monitored pregnant women spent more than half of the day performing sedentary behaviors and did not comply with the established physical activity recommendations. This sedentary behavior was directly associated with lower levels of economic income and was less significant at high levels of income.

The central idea of a physically active pregnancy as a health promoter continues to be a necessary objective and directly related to universal strategies such as the Sustainable Development Goals proposed by the United Nations (SDG) [93], specifically with objectives 3 (to ensure healthy lives and promote well-being for all at all ages) and 5 (to achieve gender equality and empower all women and girls); but this undoubtedly still needs greater promotion, especially from institutions in charge of the health of pregnant women. The lack of progress in the different regions could be explained by the fact that, although more than 70% of countries have an operational physical activity policy, the scale and scope of its implementation has not yet had a national impact [94,95].

Future studies in this scientific field should focus on the prevalence of physical activity during pregnancy in different populations and its relationship with different maternal, fetal and newborn parameters during and after the gestational period. In addition, it is necessary to pay attention to determining the barriers that pregnant women face in their limited access (currently) to the regular and safe practice of physical activity and even more if this low level of practice is in some way affecting the health of the mother and child. The main limitation observed in the present work is the diversity of intervention designs presented by the analyzed studies, which logically prevents generalization in the analysis and discussion of the results, affecting, to a certain extent, the validity of the conclusions reached. Another limitation to consider is related to the different gestational periods studied by the different authors, which naturally causes significant heterogeneity in the targeting of the periods of pregnancy in which the results of each investigation were obtained.

This article provides an updated view of worldwide data on the level of physical exercise performed by different pregnant populations around the world. Health practitioners should continue to promote moderate physical activity during pregnancy; in fact, not reaching 150 min of weekly moderate physical activity could mean significant risks in all areas of maternal health (physiological, mental, emotional) and child health. From the research point of view, new clinical guidelines, and recommendations for exercise during pregnancy, should be developed in different settings.

5. Conclusions

The results of the present study allow us to conclude that even though in the last 15 years there has been a significant increase in physical practice in the pregnant population, the current levels observed in the present review are still very far from the universal recommendations proposed by international organizations in their related publications.

Supplementary Materials: The following supporting information can be downloaded at: <https://www.mdpi.com/article/10.3390/jcm11154638/s1>, Table S1: PICOS framework.

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