Received: 11 March 2023 | Revised: 6 October 2023 | Accepted: 8 October 2023

DOI: 10.1002/ijgo.15209

CLINICAL ARTICLE

Obstetrics

# Replacement of watching television with physical activity and the change in gestational diabetes mellitus risk: A case–control study

Malak Kouiti[1,2] | Macarena Lozano-Lorca[1,3] | Ibtissam Youlyouz-Marfak[2] | Juan Mozas-Moreno[3,4,5,6] | Carla González-Palacios Torres[1] | Rocío Olmedo-Requena[1,3,4] | Alfredo Gea[7,8] | José Juan Jiménez-Moleón[1,3,4]

[1]Departamento de Medicina Preventiva y Salud Publica, Universidad de Granada, Granada, Spain

[2]Laboratory of Health Sciences and Technologies, Higher Institute of Health Sciences, Hassan First University of Settat, Settat, Morocco

[3]Instituto de Investigación Biosanitaria ibs. Granada, Granada, Spain

[4]Consorcio Centro de Investigación Biomédica en Red de Epidemiología y Salud Pública (CIBERESP), Madrid, Spain

[5]Departamento de Obstetricia y Ginecología, Universidad de Granada, Granada, Spain

[6]Obstetrics and Gynecology Service, Virgen de las Nieves University Hospital, Granada, Spain

[7]Department of Preventive Medicine and Public Health, University of Navarra, Pamplona, Spain

[8]Consortium for Biomedical Research Networking Center for Physiopathology of Obesity and Nutrition (CIBEROBN), Institute of Health Carlos III, Madrid, Spain

**Correspondence**
Macarena Lozano-Lorca, Department of Preventive Medicine and Public Health, School of Medicine, University of Granada, Avda. de la Investigación, 18012 Granada, Spain.
Email: macarenalozano@ugr.es

## Abstract

**Objective:** To evaluate the effect of replacing 1 h/week of watching television with 1 h/week of light to moderate (LMPA) or vigorous physical activity (VPA) before and during pregnancy on the risk of gestational diabetes mellitus (GDM).

**Methods:** A case–control study was conducted in pregnant women. Physical activity and television watching before and during pregnancy were assessed using the Paffenbarger Physical Activity Questionnaire. Each type of activity was classified according to intensity (metabolic equivalent of task; MET): less than 6 METs is LMPA, 6 METs or more is VPA. The duration of physical activity and watching television was calculated, and logistic regression models were used to estimate adjusted odds ratios (aOR) and 95% confidence intervals for their association with GDM risk. The isotemporal substitution model was used to calculate the effect of replacing 1 h/week of watching television with the same duration of physical activity.

**Results:** The GDM cases ($n = 290$) spent less time performing VPA than controls without GDM ($n = 1175$) and more time watching television during pregnancy ($P < 0.05$). During pregnancy, the risk of GDM increased for each hour of watching television (aOR = 1.02; 95% confidence interval 1.00–1.03). Women who spent more time watching television during pregnancy were likely to develop GDM ($aOR_{>14\,h/week\ vs.\ 0–6\,h/week} = 2.03$; 95% confidence interval 1.35–3.08). Replacing 1 h/week of watching television with 1 h/week of VPA during pregnancy could decrease the chance of developing GDM (aOR = 0.66; 95% confidence interval 0.43–1.00).

**Conclusions:** A simple change of 1 h/week of watching television for 1 h/week of VPA in pregnant women may reduce the risk of GDM considerably.

Alfredo Gea and José J. Jiménez-Moleón contributed equally.

**Funding information**
FIS Scientific Research Project, Grant/Award Number: PI 03/1207; Junta de Andalucía Excellence Project, Grant/Award Number: CTS 05/942; Universidad de Granada/CBUA

**KEYWORDS**
case–control studies, gestational diabetes mellitus, Isotemporal substitution model, physical activity, pregnancy, watching television

## 1 | INTRODUCTION

Gestational diabetes mellitus (GDM) is the most frequent pregnancy complication, representing 75%–90% of cases of hyperglycemia during pregnancy.[1] Furthermore, GDM is associated with a high risk of cesarean, preterm delivery, and macrosomia.[2] In the long term, women with GDM antecedents show an increased incidence of type 2 diabetes mellitus, cardiovascular diseases, and kidney diseases.[3,4] Epidemiological studies affirm the importance of regular physical activity and little sedentary behavior to prevent pregnancy complications such as GDM, gestational weight gain, preterm birth, and some neonatal outcomes, like macrosomia and birth trauma.[5–9] In particular, high sedentary behavior can increase the risk of maternal and fetal health outcomes.[7,10] In this sense, WHO recommends that pregnant women replace sedentary behaviors with any intensity of physical activity.[11]

Although it is known that physical activity prevents GDM,[12] results related to the most effective type of physical activity and intervention strategies for preventing GDM remain inconclusive.[13,14] This may be because previous intervention studies did not reach the minimum level of physical activity necessary to reduce GDM.[15] In addition, we must consider that a day is limited to 24 h and spending time on one activity may substitute the realization of another.[16] In this way, the behavior replaced shows an influence over the magnitude of the effect on other pathologies such as depression and type 2 diabetes.[17,18] Although a traditional model does not consider possible differences produced by removing or reallocating other behaviors, the isotemporal substitution model allows us to evaluate the effect of behavior replacement.[16] To our knowledge, this is the first study to assess the effect of replacing time spent watching television with physical activity on the risk of GDM.

Considering all of the above and that pregnant women tend to reduce their physical activity practice and spend more time in sedentary behaviors during pregnancy,[10,19–22] we aimed to estimate the effect of replacing 1 h/week of watching television with 1 h/week of light to moderate (LMPA) or vigorous physical activity (VPA) before and during pregnancy on the risk of GDM.

## 2 | MATERIALS AND METHODS

### 2.1 | Study design, setting, and participants

This case–control study consisted of pregnant women with GDM (cases) and pregnant women without GDM (controls). It was conducted in the catchment area of Virgen de las Nieves University Hospital of Granada, Spain (Project of Excellence of the Junta de Andalucía CTS 05/942). This project was approved by the Ethics Committee of the University of Granada and Virgen de las Nieves Hospital.

All women included met the following inclusion criteria: (1) age equal to or older than 18 years; (2) Spanish nationality; (3) singleton pregnancy; (4) pregnancy without complications, and (5) included in the Andalusian Program of Infant–Maternal Health, with universal and public coverage. In addition, cases had to be diagnosed with GDM, as described below. One in five women who attended the programmed visit at 20–22 weeks of gestation were systematically informed about the study; informed consent was obtained for participation. The study methodology has been described in detail previously.[23]

### 2.2 | Outcome assessment

Cases of GDM were identified weekly among the pregnant women interviewed by consulting the 50 g glucose and oral glucose tolerance test results (24–28 weeks of gestation). In this way, GDM was diagnosed according to the National Diabetes Data Group criteria. Cut-off points were determined for the time points, fasting, 1, 2, and 3 h, as 105, 190, 165, and 145 mg/dL, respectively. Participants were attributed to the case group if at least two measurements equaled or exceeded the cut-off point. The control group had a negative 50 g glucose challenge test (<140 mg/dL) or a positive 50 g glucose test (≥140 mg/dL) and a negative diagnostic oral glucose tolerance test.[27]

In total, 1222 controls and 299 cases were initially invited to participate. The final sample for this analysis comprised 1175 healthy pregnant women and 290 pregnant women diagnosed with GDM (Figure 1).

### 2.3 | Physical activity and television-watching assessment

Information on physical activity and television watching were collected for 1 year before and during pregnancy using the Paffenbarger Physical Activity Questionnaire, validated for Spanish pregnant women.[24,25] Physical activity was differentiated as: leisure-time physical activity, including walking, cycling, swimming, aerobic activity, dancing, mountain excursions, gym, and gardening. Frequency (days per week) and duration (minutes per session) were collected for each activity. Leisure-time physical activities were categorized as: (1) LMPA, including walking, gym, swimming, and gardening

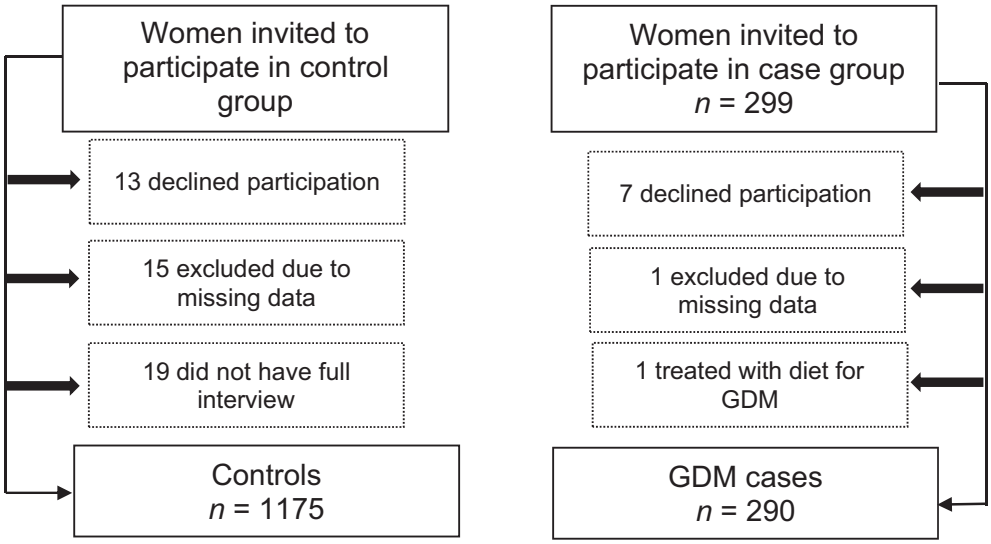


**FIGURE 1** Participant flowchart.

(metabolic equivalent of task [MET] <6); and (2) VPA, including cycling, aerobics activities, dancing, and mountain hiking (METs ≥ 6) according to Be et al.[26]

Other physical activities and information related to occupational, household, and displacement activities were collected.

In this way, the time (h/week) of LMPA, VPA, and watching television before and during pregnancy was calculated. These variables were categorized based on the distribution of controls (LMPA 0; >0–≤1; >1–≤3.75; >3.75 h/week; VPA 0; >0–≤2.5; >2.5 h/week; watching television ≥0–≤6; >6–≤ 2.25; >12.25–≤14; >14 h/week).

In addition, the joint effect of LMPA–watching television and VPA–watching television before and during the pregnancy was evaluated from the median of the control group. Thus, four categories were derived by combining low or high LMPA with low or high watching television. Similarly, the combined effect of VPA–watching television was analyzed.

## 2.4 | Covariate assessment

Sociodemographic characteristics, lifestyle habits, anthropometrics, antecedents, and obstetrics data were requested. In addition, information on diet was collected using an adapted and validated food frequency questionnaire.[28] Using this, the adherence to a Mediterranean diet was classified using the Mediterranean Diet score proposed by Trichopoulou et al.[29] as: low (0–3 points), medium (4–5 points), and high adherence (≥6 points).

## 2.5 | Statistical analysis

Participant characteristics were reported as mean and standard deviation for quantitative variables, and percentages for categorical variables. The comparison between GDM cases and controls was performed using the $\chi^2$ or Student *t*-test for categorical and continuous variables, respectively.

Logistic regression models were used to estimate the odds ratio and 95% confidence interval for the association between leisure-time physical activity (LMPA and VPA), watching television, and the joint effect of LMPA–watching television and VPA–watching television before and during pregnancy on the GDM risk. The following confounder factors were used for adjustment: maternal age, body mass index (BMI, calculated as weight in kilograms divided by the square of height in meters), educational level, smoking, GDM antecedent, Mediterranean diet adherence, and energy intake. Additionally, the logistic regression models used to evaluate the association between GDM and physical activity (LMPA and VPA) were adjusted by watching television and watching television models by LMPA and VPA.

The effect produced by replacing 1 h/week watching television with 1 h/week of LMPA or VPA on the risk of GDM was analyzed through isotemporal substitution models. Odds ratios and 95% confidence interval were estimated as the difference between the beta coefficient of the two activities studied and then exponentiated. The odds ratio reflects the reduction in GDM risk that is observed when the mean time spent in LMPA or VPA increased by 1 h/week because the mean time spent watching television decreased by 1 h/week.

We also conducted sensitivity analyses by rerunning the isotemporal substitution model, excluding women with family diabetes mellitus antecedents, those with a BMI of 30 or more, those older than 35 years, and with two or more pregnancies (see Table S1).

The statistical analysis was performed using STATA 15.0 (StataCorp LLC, College Station, TX, USA). All statistical tests were two-sided, and statistical significance was set at *P* less than 0.05.

## 3 | RESULTS

### 3.1 | Study population

Cases with GDM were older, most often had obesity, and gained more weight during pregnancy until recruitment than the controls. In addition, the cases with GDM more often had a history of abortion, were more likely to be multiparous, and more frequently had GDM and diabetes mellitus family antecedents ($P < 0.001$) (Table 1). Lifestyle habits, including smoking, alcohol consumption, energy intake, Mediterranean diet adherence, leisure-time physical activity, and watching television before and during pregnancy of cases and controls, are shown in Table 2. GDM cases consumed more energy before pregnancy than controls ($P = 0.040$). Regarding leisure-time physical activity and watching television, differences between GDM cases and controls were observed during pregnancy; GDM cases spent less time performing VPA than controls (0.06 vs 0.15 h/week) and more time watching television (16.01 vs 13.97 h/week).

### 3.2 | Association between leisure-time physical activity and watching television before and during pregnancy on the risk of GDM

Table 3 shows the association between leisure-time physical activity, watching television, the joint effect of LMPA–watching television and VPA–watching television on the GDM risk. During pregnancy, for each hour of VPA performed, the probability of GDM

**TABLE 1** Sociodemographic, anthropometric, antecedent, and obstetric characteristics of gestational diabetes mellitus (GDM) cases and controls.

| | Controls ($n = 1175$) | GDM cases ($n = 290$) | *P*-value |
|---|---|---|---|
| Maternal age (years), mean (SD) | 29.80 (5.14) | 33.49 (5.51) | <0.001 |
| <25 | 178 (15.1) | 18 (6.2) | <0.001 |
| 25–29 | 345 (29.4) | 49 (16.9) | |
| 30–34 | 436 (37.1) | 91 (31.4) | |
| 35–39 | 199 (16.9) | 95 (32.8) | |
| ≥40 | 17 (1.5) | 37 (12.7) | |
| Educational level | | | 0.157 |
| Primary | 478 (40.7) | 136 (46.9) | |
| Secondary | 339 (28.8) | 74 (25.5) | |
| University | 358 (30.5) | 80 (27.6) | |
| Body mass index[a] | | | <0.001 |
| Normal weight | 786 (67.0) | 117 (40.3) | |
| Overweight | 267 (22.8) | 80 (27.6) | |
| Obesity | 120 (10.2) | 93 (32.1) | |
| Missing | 2 | - | |
| Gestational weight gain (kg), mean (SD) | 3.71 (3.51) | 5.41 (5.13) | <0.001 |
| Previous abortion | | | <0.001 |
| 0 | 933 (79.4) | 202 (69.3) | |
| 1 | 199 (16.9) | 68 (23.4) | |
| ≥2 | 43 (3.7) | 21 (7.3) | |
| Pregnancies | | | <0.001 |
| 0 | 555 (47.2) | 106 (36.5) | |
| 1 | 365 (31.1) | 89 (30.7) | |
| 2 | 168 (14.3) | 56 (19.3) | |
| 3 | 61 (5.2) | 22 (7.6) | |
| ≥4 | 26 (2.2) | 17 (5.9) | |
| GDM antecedents | | | <0.001 |
| No | 1152 (98.0) | 233 (80.3) | |
| Yes | 23 (2.0) | 57 (19.7) | |
| Family diabetes mellitus antecedents | | | <0.001 |
| No | 875 (74.5) | 156 (53.8) | |
| Yes | 300 (25.5) | 134 (46.2) | |

*Note*: Data are *n* (%) except if mean (SD) is indicated.

Abbreviation: SD, standard deviation.

[a]Calculated as weight in kilograms divided by the square of height in meters.

**TABLE 2** Lifestyle behaviors before and during pregnancy of cases and controls.

| | Before pregnancy | | | During pregnancy | | |
|---|---|---|---|---|---|---|
| | Controls ($n=1175$) | GDM cases ($n=290$) | *P*-value | Controls ($n=1175$) | GDM cases ($n=290$) | *P*-value |
| Smoking | | | | | | |
| Never | 504 (42.9) | 110 (37.9) | 0.188 | 504 (42.9) | 110 (37.9) | 0.207 |
| Ex-smoker | 242 (20.6) | 72 (24.8) | | 242 (20.6) | 71 (24.8) | |
| Quit smoking | – | – | | 209 (17.8) | 59 (20.3) | |
| Smoker | 429 (36.5) | 108 (37.2) | | 220 (18.7) | 49 (16.9) | |
| Alcohol consumption (g), mean (SD) | 2.41 (4.24) | 2.61 (4.14) | 0.460 | 0.10 (0.67) | 0.06 (0.32) | 0.306 |
| Energy intake (kcal/day), mean (SD) | 2593.69 (808.75) | 2706.64 (959.79) | 0.040 | 2563.27 (779.98) | 2494.84 (834.20) | 0.187 |
| Mediterranean diet adherence | | | | | | |
| Low | 725 (61.7) | 171 (59.0) | | 446 (38.0) | 112 (38.6) | 0.663 |
| Medium | 377 (32.1) | 102 (35.2) | 0.604 | 512 (43.6) | 131 (45.2) | |
| High | 73 (6.2) | 17 (5.87) | | 217 (18.5) | 47 (16.2) | |
| LMPA (h/week), mean (SD) | 2.60 (3.75) | 2.38 (3.59) | 0.372 | 2.73 (3.39) | 2.73 (3.76) | 0.984 |
| VPA (h/week), mean (SD) | 0.76 (2.03) | 0.52 (1.41) | 0.058 | 0.15 (0.67) | 0.06 (0.27) | 0.025 |
| Watching television (h/week), mean (SD) | 12.95 (9.13) | 13.95 (9.69) | 0.100 | 13.97 (9.76) | 16.01 (10.93) | 0.002 |

*Note*: Data are *n* (%) except if mean (SD) is indicated.

Abbreviations: GDM, gestational diabetes mellitus; LMPA, light to moderate physical activity; SD, standard deviation; VPA, vigorous physical activity.

reduced (adjusted odds ratio [aOR] = 0.72; 95% confidence interval 0.48–1.07), whereas for each hour watching television, the risk increased (aOR = 1.02; 95% confidence interval 1.00–1.03). In this way, those women who spent more time watching television during pregnancy were approximately twice as likely to develop GDM ($aOR_{>14\,h/week\ vs\ 0-6\,h/week} = 2.03$; 95% confidence interval 1.35–3.08). When combining LMPA–watching television, those women with low LMPA and high watching television during pregnancy presented the highest risk of GDM (aOR = 1.76; 95% confidence interval 1.14–2.71). A similar behavior was observed for the joint effect of VPA–watching television (aOR = 1.62; 95% confidence interval 0.86–3.05) for women with low VPA and high watching television.

### 3.3 | Substitution of watching television with LMPA and VPA before and during pregnancy

Replacing 1 h/week of watching television with 1 h/week of VPA during pregnancy may reduce the likelihood of developing GDM (aOR = 0.66; 95% confidence interval 0.43–1.00). However, no association was observed when replacing 1 h of watching television with 1 h of LMPA (Table 4). Sensitivity analysis performed excluding women at high risk of developing GDM did not show substantial changes with previous results (see Table S1).

## 4 | DISCUSSION

To our knowledge, this is the first study to assess the effect of replacing 1 h/week of watching television with 1 h/week of LMPA or VPA on the risk of GDM. Briefly, women with GDM performed less physical activity and spent more time watching television than controls during pregnancy. Performing VPA during pregnancy seems to reduce the probability of GDM. In addition, replacing 1 h/week of watching television with 1 h/week of VPA during pregnancy could reduce GDM risk by 34%.

The association between physical activity and GDM has been mainly studied using a traditional method based only on identifying associated factors (e.g. multivariant logistic regression). This approach does not consider possible differences due to the removal or reallocation of other behaviors, which can be analyzed using the isotemporal substitution model.

Our results suggest that performing VPA during pregnancy could reduce the probability of GDM, whereas watching television increases the likelihood of GDM. However, only 19.4% and 27.5% of participants met leisure-time physical activity recommendations before and during pregnancy, respectively, as described previously.[22] In line with our results, Oken et al.[30] did not report any association for LMPA, whereas VPA seemed to protect against GDM, although no statistically significant association was observed due to possible precision issues (only 91 cases of GDM and a cohort design). Likewise, a cohort study of 2388 American pregnant women showed that VPA improved maternal glucose metabolism.[31] In addition, the results of the Nurses Health Study II and Wagnild et al.[32] suggested that watching television could increase GDM, findings similar to ours.[33] In contrast, no association was observed between watching television and GDM in two cohorts conducted in Eastern and Singapore populations.[30,34] These last two cohorts were characterized by moderate to small sample sizes for cohort studies. These cohorts were realized with populations at high risk of GDM (e.g. in Padmapriya et al.,[34] the prevalence of GDM was 18.6%). In this type of population, it may be difficult to correctly

**TABLE 3** Association between physical activity and watching television before and during pregnancy on the risk of gestational diabetes mellitus (GDM).

| | Before pregnancy | | During pregnancy | |
|---|---|---|---|---|
| | Controls/GDM cases | aOR (95% CI)[a] | Controls/GDM cases | aOR (95% CI)[b] |
| LMPA (h/week) | | | | |
| For each hour | | 0.97 (0.93–1.02) | | 1.00 (0.96–1.05) |
| 0 | 389 (33.1)/112 (38.6) | Reference | 310 (26.4)/85 (29.3) | Reference |
| >0–≤1 | 214 (18.2)/38 (13.1) | 0.58 (0.37–0.92) | 278 (23.7)/44 (15.2) | 0.58 (0.38–0.91) |
| >1–≤3.75 | 284 (24.2)/78 (26.9) | 0.85 (0.58–1.24) | 319 (27.1)/90 (31.0) | 0.97 (0.66–1.42) |
| >3.75 | 288 (24.5)/62 (21.4) | 0.60 (0.40–0.90) | 268 (22.8)/71 (24.5) | 0.94 (0.62–1.42) |
| VPA (h/week) | | | | |
| For each hour | | 0.95 (0.87–1.05) | | 0.71 (0.48–1.06) |
| 0 | 855 (72.8)/221 (76.2) | Reference | 1065 (90.6)/269 (92.8) | Reference |
| >0–≤2.5 | 196 (16.7)/49 (16.9) | 1.02 (0.68–1.51) | 90 (7.7)/21 (7.2) | 1.03 (0.59–1.80) |
| ≥2.5 | 124 (10.5)/20 (6.9) | 0.82 (0.47–1.40) | 20 (1.7)/0 (0.0) | – |
| Watching television (h/week) | | | | |
| For each hour | | 1.00 (0.99–1.02) | | 1.02 (1.00–1.03) |
| ≥0–≤6 | 209 (17.8)/54 (18.6) | Reference | 184 (15.7)/42 (14.5) | Reference |
| >6–≤12.25 | 356 (30.3)/74 (25.5) | 0.88 (0.56–1.38) | 331 (28.2)/64 (22.0) | 0.90 (0.55–1.47) |
| >12.25–≤14 | 333 (28.3)/78 (26.9) | 0.95 (0.61–0.50) | 333 (28.3)/77 (26.5) | 1.05 (0.64–1.70) |
| >14 | 277 (23.6)/84 (29.0) | 1.10 (0.69–1.77) | 327 (27.8)/107 (36.9) | 1.51 (1.93–2.45) |
| Joint effect LMPA–watching television | | | | |
| High LMPA–low watching television | 451 (38.4)/108 (37.3) | Reference | 429 (36.5)/103 (35.5) | Reference |
| High LMPA–high watching television | 121 (10.3)/32 (11.0) | 0.98 (0.59–1.66) | 158 (13.4)/43 (14.8) | 1.15 (0.72–1.84) |
| Low LMPA–low watching television | 447 (38.0)/98 (33.8) | 1.09 (0.77–1.54) | 419 (35.7)/80 (27.6) | 0.84 (0.58–1.21) |
| Low LMPA–high watching television | 156 (13.3)/52 (17.9) | 1.45 (0.91–2.29) | 169 (14.4)/64 (22.1) | 1.76 (1.14–2.71) |
| Joint effect VPA–watching television | | | | |
| High VPA–low watching television | 266 (22.6)/57 (19.7) | Reference | 89 (7.6)/17 (5.9) | Reference |
| High VPA–high watching television | 54 (4.6)/12 (4.1) | 0.86 (0.39–1.90) | 21 (1.8)/4 (1.4) | 0.77 (0.19–3.11) |
| Low VPA–low watching television | 632 (53.8)/149 (51.4) | 0.99 (0.67–1.44) | 759 (64.6)/166 (57.2) | 0.99 (0.54–1.80) |
| Low VPA–high watching television | 223 (19.0)/72 (24.8) | 1.24 (0.78–1.97) | 306 (26.0)/103 (35.5) | 1.62 (0.86–3.05) |

Abbreviations: aOR, adjusted odds ratio; CI, confidence interval; LMPA, light to moderate physical activity; VPA, vigorous physical activity.

[a]Adjusted for maternal age, body mass index (calculated as weight in kilograms divided by the square of height in meters), education level, smoking before pregnancy, GDM antecedents, Mediterranean diet adherence before pregnancy, and energy intake before pregnancy.

[b]Adjusted for maternal age, body mass index (calculated as weight in kilograms divided by the square of height in meters), education level, smoking during pregnancy, GDM antecedents, Mediterranean diet adherence during pregnancy, and energy intake during pregnancy.

estimate the magnitude of the effect of risk factors such as physical activity and sedentary behavior on the risk of GDM as a consequence of the presence of other risk factors.

Our findings related to the isotemporal substitution model show that replacing 1 h/week of watching television with 1 h/week of VPA during pregnancy could reduce the risk of GDM by 34%. These results cannot be compared with other literature, as no previous study has been found that used the isotemporal substitution model for GDM. Our study supports the importance of reducing the time spent watching television and instead performing physical activity, especially during pregnancy. A protective effect on GDM is observed when watching television is replaced by VPA. However, current guidelines recommend that pregnant women engage in moderate physical activity,[21,35] which might not be enough to protect against GDM.[15] Therefore, these results could have important clinical implications.

Until several decades ago, physical activity had been discouraged in pregnancy due to theoretical concerns of exercise-induced injury leading to adverse fetal and maternal outcomes.[36] However, some evidence from observational studies has suggested that the risk of GDM was decreased by 20%–55% among women with physical exercise of varying durations and intensity before or during pregnancy.[30,33,37] These studies support the performance of pregnancy-appropriate VPA as long as there is no prior contraindication for the woman. An example of exercise could be aerobic arm exercises or any other VPA that does not stimulate the production of uterine contractions.

**TABLE 4** Substitution of 1 h/week of watching television with 1 h/week of physical activity on the risk for gestational diabetes mellitus (GDM).

| | Before pregnancy | | During pregnancy | |
|---|---|---|---|---|
| | aOR 95% CI[a] | *P*-value | aOR 95% CI[b] | *P*-value |
| LMPA replacement | 0.97 (0.93–1.02) | 0.227 | 0.99 (0.95–1.04) | 0.724 |
| VPA replacement | 0.95 (0.87–1.05) | 0.328 | 0.66 (0.43–1.00) | 0.049 |

Abbreviations: aOR, adjusted odds ratio; CI, confidence interval; LMPA, light to moderate physical activity; VPA, vigorous physical activity.

[a]Adjusted for maternal age, body mass index (calculated as weight in kilograms divided by the square of height in meters), education level, smoking before pregnancy, GDM antecedents, Mediterranean diet adherence, and energy intake before pregnancy.

[b]Adjusted for maternal age, body mass index (calculated as weight in kilograms divided by the square of height in meters), education level, smoking during pregnancy, GDM antecedents, Mediterranean diet adherence, and energy intake during pregnancy.

Some limitations should be considered when interpreting our findings. First, physical activity was derived from a self-reported questionnaire (based on the Paffenbarger questionnaire). This form of collecting information related to physical activity is the most frequently used in epidemiological studies. The questionnaire used in our study to assess physical activity has been used previously and validated for Spanish pregnant women.[25] We would have liked to analyze the role of physical activity in developing a hydrocarbon intolerance during pregnancy. This would have allowed us to analyze a possible dose–response effect. However, we used a case–control design and this relationship cannot be studied. On the other hand, our study has some strengths: (1) to our knowledge, it is the first study analyzing the association between physical activity, watching television, and GDM risk using an isotemporal substitution model; (2) a large sample size was included in our analyses; (3) our sample is representative of healthy Spanish women in the south of Spain. Furthermore, the loss of participants for not attending the programmed visits was minimal, as prenatal care protocol covers up to 99% of the population of pregnant women in the public hospital; (4) most GDM cases (97.0%) and controls (96.2%) had detailed information about physical activity; (5) residual confounders, such as Mediterranean diet adherence, smoking, GDM antecedents, and energy intake, were measured and adjusted for. However, we cannot rule out the absence of confounding by other exposures/agents related to physical activity, television watching, and GDM.

## 5 | CONCLUSIONS

A simple change of 1 h/week of watching television for 1 h/week of VPA in pregnant women may reduce the risk of GDM considerably. In this way, our finding reinforces the potential benefits of pregnancy-appropriate physical activity and reducing sedentary behaviors, specifically the time spent watching television, on GDM risk.

### AUTHOR CONTRIBUTIONS

José J. Jiménez-Moleón designed the study. Malak Kouiti, Macarena Lozano-Lorca, and Carla González-Palacios Torres performed the analyses. José J. Jiménez-Moleón, Ibtissam Youlyouz-Marfak, Juan Mozas-Moreno, Rocío Olmedo-Requena, and Alfredo Gea verified the analyses. Malak Kouiti and Macarena Lozano-Lorca wrote the first draft of the manuscript. All authors have read, approved the content, and contributed to the work.

### ACKNOWLEDGMENTS

The results of this study are part of the doctoral thesis of Malak Kouiti.

### FUNDING INFORMATION

This research was funded by FIS Scientific Research Project PI 03/1207 and Junta de Andalucía Excellence Project CTS 05/942.

### CONFLICT OF INTEREST STATEMENT

The authors have no conflicts of interest.

### DATA AVAILABILITY STATEMENT

Research data are not shared.

### ORCID

*Macarena Lozano-Lorca* https://orcid.org/0000-0001-5282-814X

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## SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

**How to cite this article:** Kouiti M, Lozano-Lorca M, Youlyouz-Marfak I, et al. Replacement of watching television with physical activity and the change in gestational diabetes mellitus risk: A case–control study. *Int J Gynecol Obstet*. 2023;00:1-8. doi:10.1002/ijgo.15209