Beyond the individual: socio-ecological factors impacting activity after Gestational Diabetes Mellitus

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RESEARCH ARTICLE

Beyond the individual: Socio-ecological factors impacting activity after gestational diabetes mellitus

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Abstract

Aim: The risk of Type 2 Diabetes is 10 times higher after a pregnancy with Gestational Diabetes. Physical activity can independently reduce this risk, yet engagement with physical activity remains low after Gestational Diabetes. Therefore, the present study aimed to explore the barriers and facilitators to the uptake of physical activity after Gestational Diabetes in the United Kingdom, using a socio-ecological approach.

Methods: The paper was written following the Standards for Reporting Qualitative Research. Patient and Public Involvement contributed to the study's conceptualisation and design. Participants were recruited through an audit of Gestational Diabetes cases at a local Teaching Hospital in 2020. Twelve participants took part in semi-structured one-to-one interviews. Reflexive thematic analysis was used to generate themes in iterative rounds of refinement. The final themes were then organised using the socio-ecological model.

Results: Participants were all over 31 years old, predominantly self-identified as White British and were all in employment but were evenly spread across UK-based deprivation deciles. Ten themes were generated and organised according to the four levels of the socio-ecological model: intrapersonal (beliefs about activity, recovering from birth), social (health care professionals, family and partner, role as a mother), organisational (access and cost, environment, childcare and work) and community (connecting women with recent Gestational Diabetes).

Conclusions: Many of the amenable barriers and facilitators to physical activity were beyond the intrapersonal level, based on higher levels of the socio-ecological model (social, organisational and community). Multi-level interventions are needed to effectively address all barriers.

KEYWORDS

exercise, gestational diabetes mellitus, maternal health, physical activity, socio-ecological model, type 2 diabetes mellitus, prevention

1 | INTRODUCTION

Gestational Diabetes is a type of glucose intolerance that first appears in pregnancy.[1] In the United Kingdom, the prevalence of gestational diabetes was estimated at 20.6% in 2021, but rates are steadily increasing.[2] Several chronic conditions are associated with a Gestational Diabetes diagnosis.[3] For example, risk of Type 2 Diabetes is ten times higher in women with previous Gestational Diabetes. Costs related to Type 2 Diabetes diagnosis and treatment are rising and are currently estimated to cost the UK National Health Service (NHS) £14 billion annually.[4] Patients with Type 2 Diabetes have also reported that managing the condition is burdensome and can have substantial impacts on mental health.[5,6] Reducing this risk is thus a clinical priority.[7,8]

A combination of lifestyle behaviours, including diet, physical activity (PA) and weight management, has been shown to reduce the risk of progression to Type 2 Diabetes by 50%.[9–11] However, PA can independently reduce this risk, with data from the Nurses' Health Study II cohort suggesting a risk reduction of 9% for every 100 minutes of moderate PA per week undertaken, even after adjusting for BMI.[12] Yet, PA tends to decrease from pre-pregnancy to postpartum.[13] Factors associated with declining PA include lack of childcare, working longer hours and postpartum weight retention.[14] Additionally, uptake of PA is not effectively encouraged after Gestational Diabetes.[15] This could be because diabetes prevention initiatives are targeted at the general population, who may not experience the unique barriers present for women with young families.[16,17] Factors impacting PA engagement after Gestational Diabetes require further investigation.

Recently, a review exploring barriers and facilitators to PA in women after Gestational Diabetes has been published.[18] However, only two of the included studies focused solely on PA.[19,20] Jakobsen et al., recently undertook a phenomenological approach to understanding the perceptions and motivations for PA in women after Gestational Diabetes.[21] These studies focus on individual motivation and experiences and do not explore barriers and facilitators to PA outside of the individual's perspective.

Increasingly, it is understood that human behaviour occurs within a complex system of influences. Focusing solely on individual-level factors such as motivation risks designing interventions that may have limited impact because wider factors continue to act as a barrier to the behaviour or could lead to a neglect of recommendations or efforts to address those wider influences.[22] The Socio-Ecological Model (SEM) depicts interrelationships between the social, physical and policy environments surrounding individuals.[23] It is a useful model for understanding wider influences on individual (health) behaviours[24] and can highlight parts of a system to target through the lens of interpersonal, social, organisational and community levels. The present study aimed to explore barriers and facilitators to the uptake of PA after Gestational Diabetes using the SEM to better understand the range of influences and contexts on PA.

What's new?

What is already known?

Physical activity independently reduces the risk of Type 2 Diabetes after Gestational Diabetes, but engagement is low. Qualitative research to date focuses on exploring individual-level factors influencing physical activity.

What this study has found?

We have identified factors beyond individual control that influence physical activity after Gestational Diabetes. These include social and organisational factors, like support from partners or contacts with healthcare professionals, and a lack of childcare.

What are the implications of the study?

Multi-level interventions are needed to effectively target barriers to physical activity at multiple levels of the system. Organisations and system-level actors need to take steps to support individuals to engage in physical activity after Gestational Diabetes.

2 | METHODS

The present paper was written in accordance with the Standards for Reporting Qualitative Research (SRQR).[25]

2.1 | Study context

The study took place in a city in North East England. The city is one of the 20% most deprived areas in England,[26] with an ethnicity split broadly similar to that of England and Wales (as of the 2021[27] census): 79.1% White, 9.6% Asian, Asian British or Asian Welsh, 4.6% Black, Black British, Black Welsh, Caribbean or African and 3.5% Mixed or Multiple ethnic groups.

2.2 | Patient and public involvement (PPI)

Members of a PPI group were recruited from across the United Kingdom via social media advertisements, word of mouth and a Gestational Diabetes support group run by Diabetes UK. The PPI members had varying experiences of Gestational Diabetes and life after Gestational Diabetes; some were active, some were not, and some were diagnosed with Type 2 Diabetes.

In the development stages, the PPI group aided in the conceptualisation of the present study. In further meetings, the PPI group helped develop key questions to address in the interviews and was asked to give feedback on the draft interview schedule (supplementary file), which was amended accordingly. The semi-structured interview guide was piloted first with another researcher and then with a member of the PPI group. Following pilot interviews, the guide was refined and shortened to improve flow, clarity of questions and length. PPI members were also asked to give feedback on the study poster and information sheet, with subsequent changes made based on feedback received related to the use of plain English language.

2.3 | Sampling and recruitment

NHS ethical approval was obtained (IRAS Project ID: 312509). A research Coordinator at the local NHS Teaching Hospitals Trust identified eligible women from an audit on Gestational Diabetes cases from 2020 and sent packs with study information and consent to 350 women (Table 1). Participants were offered a £10 thank you voucher for their time if they took part in the study.

Other qualitative papers in this topic area have varied greatly in terms of sample size.[18] Consistent with Braun and Clarke's approach to reflexive thematic analysis, the concept of theoretical saturation was not applied in this study.[28] Instead, sampling ceased when no further responses were obtained after a 4-month period.[29]

TABLE 1 Summary of ethnicity and IMD of women sent participant packs.

	Number approached (%)
Maternal ethnicity	
Asian	82 (23%)
Black	25 (7%)
White	195 (56%)
Mixed	7 (2%)
Other	20 (6%)
Unknown	21 (6%)
IM decile	
1–3	220 (63%)
4–7	72 (21%)
8–10	57 (16%)

Note: $N = 350$. IMD, Index of Multiple Deprivation. Decile 1 is most deprived and Decile 10 least deprived. From https://www.gov.uk/government/statistics/english-indices-of-deprivation-2019. Data provided by Sheffield Teaching Hospital.

TABLE 2 Summary of inclusion exclusion criteria.

Inclusion criteria	Exclusion criteria
≥1 Gestational Diabetes pregnancy (<5 years)	Already diagnosed diabetes prior to most recent Gestational Diabetes pregnancy
≥6weeks postpartum	Never had a Gestational Diabetes pregnancy OR most recent Gestational Diabetes pregnancy >5 years ago
Communicate in English	Could not communicate in English

Note: <, in less or fewer than; >, in more or greater than; ≥, in at least; yrs, years.

2.4 | Data collection

One-to-one semi-structured interviews were conducted by the lead author (EI) with women who had a history of Gestational Diabetes within the past 5 years (Table 2). Participants were not excluded based on a current Type 2 Diabetes diagnosis, if the diagnosis happened after the most recent Gestational Diabetes pregnancy. Upon obtaining informed consent, interviews were conducted over the phone ($n = 6$), online (via Zoom Video Communications Inc., USA) ($n = 5$), or face-to-face ($n = 1$), as per participants' preferences. Interviews were recorded using a digital audio recorder and transcribed by a transcription company and, on average, lasted 45 min (range: 27–54 min).

2.5 | Data analysis

A reflexive thematic analysis[30] was undertaken using NVivo 12 (Lumivero, Denver, USA). Data recorded from interviews was taken to reflect the articulated meanings and experiences of participants.[31] The coding approach was initially inductive, and once final themes were generated, these were deductively organised using the SEM as a framework. Levels of the SEM are not strictly distinct; rather, they represent interrelationships. However,

inductively generated themes were subsequently aligned to whichever level of the model they might most usefully be targeted. For example, 'childcare' was aligned with the organisational level, as this is where childcare could be addressed that is, organisations could provide childcare.

A reflexive thematic analysis was undertaken following the six phases outlined by Braun and Clarke: familiarisation, initial coding, theme generation, reflection and reviewing themes, and defining and writing up the themes.[30,32] A female PhD student with a background in sport science and nutrition (EI) did the initial open coding. Two female researchers experienced in qualitative research with qualifications and applied experience in health psychology and public health (CH and HH) also independently read and coded a random sample of transcripts to discuss in the initial theme refinement. EI, HH and CH discussed and reviewed codes and themes iteratively in four rounds to aid the development and refinement of themes and to support researcher reflexivity.[33,34] These discussions included reflections about the use of the SEM, to ensure the initial inductive themes generated were data-driven, with the SEM only being used to laterly organise these themes rather than dictate them.

3 | RESULTS

3.1 | Participant characteristics

Twelve participants took part in the study. A summary of their demographic information is presented in Table 3. Compared to the potential participants invitation packs were sent to (Table 1), a high proportion of White British women, a lower proportion of Asian women and women living in more deprived areas (IMD 1–3) were recruited. Allowing choice regarding interview mode (i.e., telephone, zoom or face-to-face) aided participants' ability to take part in the interview but had no obvious impact on participants' engagement with interview questions, depth of responses or interview length.

3.2 | Themes

Ten themes were generated and organised using the levels of the SEM (Figure 1); intrapersonal ($n=2$), social ($n=3$), organisational ($n=4$) and community ($n=1$). Factors that limited or impeded PA (barriers) or supported PA (facilitators) appeared within each of these themes. Table 4 displays how these themes and the factors within them were organised.

TABLE 3 Summary characteristics of participants ($N=12$).

	n (%)
Age	
31–35 years	5 (42)
36–40 years	5 (42)
≥41 years	2 (17)
Self-identified ethnicity	
White British	8 (67)
Asian	1 (8)
Mixed race	2 (17)
Other	1 (8)
IMD decile	
1–3	3 (25)
4–7	5 (42)
8–10	2 (17)
Did not say	2 (17)
Education level	
GCSE	2 (17)
Bachelor's degree	7 (58)
Master's degree	2 (17)
Accreditation	1 (8)
Employment	
Full time	8 (67)
Part time	2 (17)
Self-employed	2 (17)
Number of children	
1	5 (42)
2	4 (33)
≥3	3 (25)
Percentage pregnancies with gestational diabetes	
25%	1 (8)
33%	2 (17)
50%	1 (8)
100%	8 (67)

Abbreviations: IMD, index of multiple deprivation, 1 is most deprived and 10 is least deprived. % is the percentage of the participants interviews.

3.2.1 | Intrapersonal level factors

Beliefs about PA

This theme summarises why participants thought they should be active. Some participants had an awareness of PA for managing Type 2 Diabetes risk or mental health as a result of their Gestational Diabetes diagnosis: "*I thought, you know what, I'm going to have to do this (PA). I don't really want diabetes. Diabetes is rubbish, and that is enough reason*." [P6]. However, many participants believed PA was helpful for mitigating Type 2 Diabetes risk through weight-management alone, rather than the independent

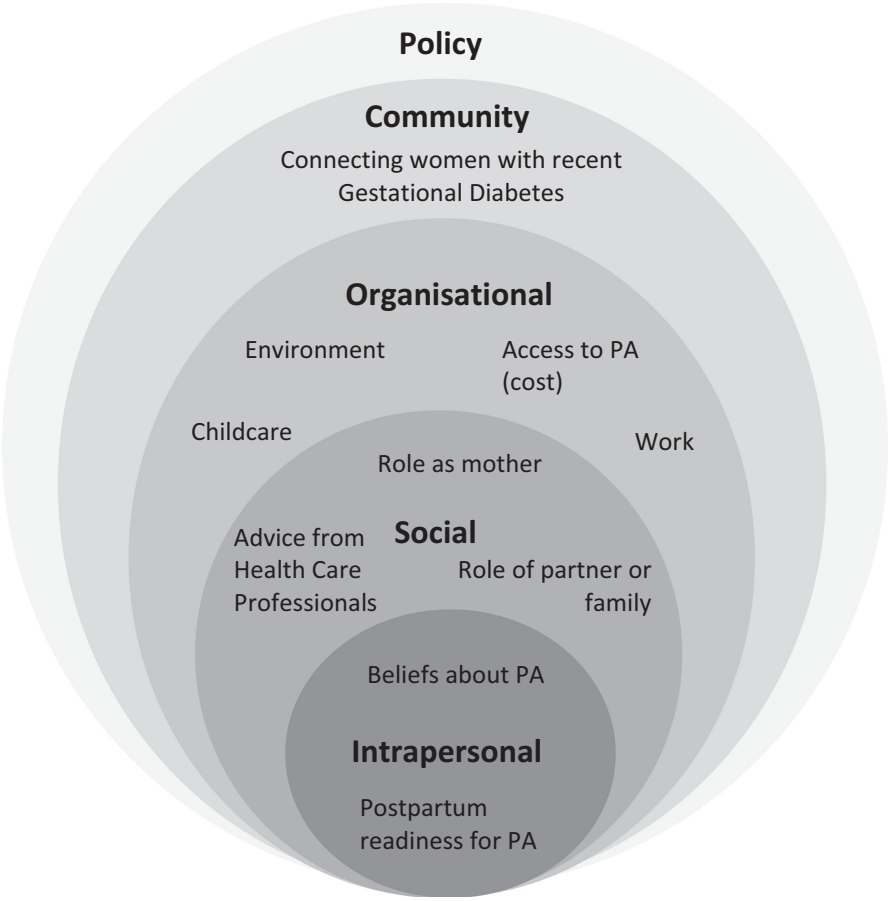

FIGURE 1 Overview of the themes (main results) appearing at each level of an adapted socio-ecological model (from McLeroy, K. R., Bibeau, D., Steckler, A., & Glanz, K. An ecological perspective on health promotion programmes. Health Educ Q. 1988;15:351–377).

benefits of PA. A focus on weight or aesthetics encouraged PA for some participants "*So I don't get fat... just to keep my weight down*." [P2]. For others a weight or aesthetic focus was negative for longer-term PA maintenance: "*I stopped seeing any physical results and stopped losing weight, I just stopped everything altogether*." [P4]. While some participants were not satisfied with their current PA levels, these tended to be when discussing purposeful leisure time exercise, and this dissatisfaction did not necessarily result in increased PA engagement.

Recovering from birth

The impact of birth on mental or physical health differentially affected the amount of time women needed to feel 'ready' to engage with PA postnatally. Participants described physical after-effects from giving birth: "*I found it took a lot of building back up to even just be able to walk that amount... I've never ever experienced anything like that. I've never ever thought I can barely walk ten minutes*." [P3]. Some took a graded approach to PA, building up from gentle movement to more purposeful exercise within the early postpartum period: "*I'd still got hip and pelvis problems. I set off walking a little bit in the first six months, and then I thought right, I'll try Couch25k, then I did Couch210k*." *[P6]*. Others described a longer recovery or cited the emotional impact and adjustment to motherhood in terms of new priorities and responsibilities, which created a more long-lasting barrier.

3.2.2 | Social level factors

Advice from Health Care Professionals

Participants felt unsupported by Health Care Professionals (HCPs) postnatally: "*There was zero support, zero, zero, zero*." *[P3]*. Participants also felt HCPs focused more on diet and weight than PA for managing the risk of Type 2 Diabetes. Other participants felt HCPs were positive and helpful: "*my doctor told me... it's quite helpful if you do walk every day. It decreases your risk level*." [P11]. Overall, most participants wanted more support postnatally and to be directed to PA-specific resources.

Role of partner or family

Participants felt they needed supportive partners and/or close family both to encourage PA and to enable time for them to undertake PA by providing help with household responsibilities (including childcare): "*he's always like, if you want to do something go off and do it, and he's happy to stay at home. He is always encouraging me*." *[P9]*. However, some participants were single mothers or had partners who worked at a distance from home and felt PA

TABLE 4 Barriers and facilitators organised according to the SEM.

SEM level	Theme/ subtheme	Barriers	Facilitators	Example quotes
Intrapersonal	***Beliefs about PA***	• Perceiving self to be unable to do PA • Bad experiences or memories of PA (history) or no consistent engagement with PA previously • Frustration with lifestyle focus • PA aesthetically driven and no longer seeing aesthetic changes	• Aware of positive mental/physical benefits of Pa • Belief PA helpful for managing Type 2 Diabetes risk and for longevity (influence of Gestational Diabetes diagnosis) • PA for weight-loss or maintenance	*"If I put on a little bit of weight I'd then think, right I need to watch what I'm eating, I need to go for a run or I need to go to a class or something...it's never been like a steady or consistent thing."* [P12] *"I suppose in the back of my mind I do always hope that I'm going to lose some weight as well."* [P6] *"I do need to be active to keep my weight under control"* [P9] *"I struggle to do formal exercise because I've got a little one, but I guess most of my activity is probably running after him or housework rather than I guess taking time for myself to go swimming which is what I used to do before." [P13]*
	Recovering from birth	• Impact of birth (traumatic), and needing time to recover mentally or physically afterwards • Poor health, feelings of fatigue or overwhelm • Needing time to adjust to new way of life and new priorities	Tailoring and periodising PA after birth	*"But it's actually motivating myself to do it in the first place I think that's difficult, especially when I'm tired"* [P10] *"So definitely now she's two. She's more settled and we're in a much better-established routine"* [P1]
Social	***Advice from HCPs***	• Lack of PA focus by HCPs in managing Type 2 Diabetes risk postnatally • Feeling unsupported postnatally and/or abandoned postpartum	Coaching, counselling, support and education throughout pre-conception to postnatal journey	*"After I'd given birth there wasn't really anything"* [P13] *"I remember someone just saying to me, they're like, oh it'll go after you've had her, like as if, almost dismiss the fact that you don't need to do anything it'll be fine, it'll just go and you'll be all right."* [P12] *"No-one's ever said anything to do with exercise to help diabetes. I believe, from the information that I've read, and people have told me, it's very much to do with your diet"* [P7] *"Somebody to check-in and somebody to touch base... or keep you updated with what support is available and what you could do"* [P1]
	Role of partner or family	No close family members nearby or not wanting to rely on family for childcare for PA	Partner encouraging PA, supporting PA and aiding with childcare for this	*"I rely on my parents a lot to have childcare while I'm at work, so then I can't then expect them to then have them additional so I can go out and do another run or go to the gym an extra day"* [P2]
	Role as mother	• Children's pace/abilities • Difficult or demanding children • Prioritise children's needs above own	• Wanting children to be active • Role modelling PA as positive thing	*"I used to be able to just put him in the buggy and go for a buggy run. And he doesn't like it as much now."* [P9] *"Just want her to have a good decent role model. So, if I'm expecting her to behave a certain way, I'd better lead by example"* [P3]

TABLE 4 Continued

SEM level	Theme/ subtheme	Barriers	Facilitators	Example quotes
Organisational	***Access (cost)***	• Cost and location of PA • Time needed to take part in PA outside of the home • Rising daily living costs, increased bills, less money left for PA (prioritise money for children's enrichments and core needs)	Practicality and flexibility to access resources	*"I'll try and save money... rather than driving short distances. Whereas normally I would have got in car and not thought anything about it, but now I pretty much walk everywhere."* [P6] *"I suppose with a lot of things like swimming or the gym it's all the other added time that goes with it, so getting to and from it, getting changed or showered if you're there. I just feel like it takes too much time out of your day"* [P12]
	Environment	Appropriate space for PA/space in the home	Opportunities for active transport (walkability)	*"I walk her to swimming sometimes. That's the only way, I mean I'm not really getting any exercise, but even just getting there and getting back"* [P3] *"So, life gets in the way. And it needs to be there, but it needs to be a flexible arrangement, do you know what I mean, not too flexible that you can get out of it"* [P7] *"I think it's quite easy to then get back into a rut of, oh well now it's dark, I don't want to go out for a run, oh it's a bit cold."* [P12]
	Childcare	• Dislike PA options when with toddler • Lack of flexible, affordable childcare	Childcare opportunities co-located in spaces for PA	*"So, we're talking a good few years ago now, there used to be a gym... you'd pay your £1.50 and they could go into this sort of nursery thing, and they'd have a snack and play, do painting and all that sort of stuff and you'd go to the gym. Now there's nothing like that."* [P7]
	Work	Work is a priority and time consuming	Workplace initiatives and opportunities for PA	*"I do not have time to do so. I'm working nine to five"* [P11] *"You can have a longer lunch break if you do some kind of wellness or physical activity, or a wellness walk or whatever that looks like. So instead of half an hour you can have an hour"* [P4]
Community	***Connecting women with recent Gestational Diabetes***	Mum and baby groups not intense enough, and limited to initial postpartum period	• Doing PA in group settings (for some) • Sharing experiences with others, peer support, connecting with other women who had Gestational Diabetes	*"I just like to see what other people are saying... that reassurance that other people are in a similar boat and are on that journey"* [P1] *"When you first start going to the gym you feel shamed because you've not got the right body type to be in a gym"* [P7] *"The thing is though, she's now two. So, the mum and baby things, I have heard of some ones but they're usually for baby babies. I think up to when they're walking because obviously when they can walk, when you're doing your exercises on a mat on a floor, usually the baby's lying next to you."* [P7]

Abbreviations: HCPs, health care professionals; PA, physical activity; SEM, socio-ecological model.

was unattainable for this reason. Most participants did not want to rely on help from other family members for the sake of PA, preferring to reserve childcare support for emergencies or for other priorities.

Role as mother

Participants identified themselves primarily as mothers, where their children's needs came first. This was often a barrier to PA: "*You are a mum and that comes first... you are last on the list of priorities*." [P7]. Participants subsequently felt guilty about engaging with PA and preferred to spend time with their children in their free time. However, some participants wanted to role model PA as a positive behaviour for their children: "*I really want exercise to be important to her*." [P1]. Wanting to ensure children were happy and fulfilled also encouraged some participants to be more active: "*I've always been a bit lazy... to go and be active. It's more, I need to get my kids out, shall we go for a walk... We'll do an activity to keep the kids busy... rather than thinking I need to do some exercise*." [P4].

3.2.3 | Organisational level factors

Access to PA (cost)

Increasing costs of daily life prompted active transport for some participants. However, for most participants, it reduced access to PA as money was prioritised for their children's benefits over, for example gym access "*I haven't got £40 a month... It's not a priority... You don't save money by not taking your kids to the play areas. So, you can't go to the gym because your kids come first*." [P7]. The distance to, for example gyms also impacted the uptake of PA in those settings, given the time constraints felt by mothers.

Childcare

The lack of childcare was one of the most significant barriers highlighted by participants: *"Yeah, it's just childcare reasons that gets in the way, I would be doing a lot more if it weren't for childcare reasons"* [P2]. The presence of childcare potentially enabled participants to be active. However, participants emphasised a lack of options for flexible, short duration and affordable childcare, which might be most helpful for enabling PA engagement: "*She goes to nursery while I'm at work, but it costs a fortune. It costs £60 or £70 a day... I could pay to put her in somewhere for an hour, but most places don't do that. Most places don't have that option*." [P6].

Environment

The walkability of the environment aided active transport, for example walking children to and from activities. Some participants preferred the flexibility of running and home-based PA, for example following YouTube videos to overcome cost and time issues: *"I like doing it at home because it fits in"* [P12]. The safety of the environment and the weather hindered PA when it was not felt safe or the weather was unpleasant to, for example run in.

Work

Being in full-time work significantly reduced the opportunity for PA due to time constraints, although some participants recognised that work-based PA initiatives existed. However, participants highlighted that they could not make use of these if other barriers were present, for example lack of childcare and the need to condense work hours. Weekends were therefore considered good opportunities for being active as a family: *"then the weekends are a bit more family time. That's when usually we have more time to go out for a proper walk"* [P7].

3.2.4 | Community level factors

Connecting women with recent gestational diabetes

Participants wanted to be connected to other women with previous Gestational Diabetes but often felt they could not do this on their own: *"It's just logistically getting together with other people that I haven't met yet... I don't know where to find these people that you can do activities with"* [P7]. Some participants preferred PA in group settings for increased motivation, accountability and enjoyment of PA: *"I wouldn't have just gone and run with my buggy I'd have wanted to have done it with a group of people"* [P12]. However, other participants would be deterred from group-based PA, depending on who was in the group: *"But then I suppose that can hinder you, because I've got friends who are so fit I'd hate to go to a class with them, because there's no way that I'd keep up"* [P12]. Participants also highlighted that mum and baby groups only catered to very young babies; not all participants were ready to engage with PA at that point and would have preferred similar opportunities when their children were older.

4 | DISCUSSION

The aim of this study was to explore barriers and facilitators to PA after Gestational Diabetes and understand these wider influences and contexts on PA using the SEM. The results highlighted how the barriers and facilitators to PA span across multiple levels of the SEM. 'Recovering from birth', 'advice from HCPs' and 'connecting women with previous Gestational Diabetes' were the main themes linked directly with the Gestational Diabetes experience. The results are discussed further below.

4.1 | Intrapersonal

Many participants described pursuing PA for weight management or body image reasons. These motives are commonly linked to experiences from school or societal pressures to conform to aesthetic female stereotypes.[35,36] For many participants in the current study, these ideals existed pre-pregnancy rather than being specific to motherhood, although weight gain and weight management associated with pregnancy were highlighted throughout the Gestational Diabetes experience. Weight-loss intentions behind PA could explain increased motivation for PA in women[37] and Type 2 Diabetes risk has been shown to decrease with weight-loss.[38] However, for some of our participants, fluctuations in weight and an aesthetically driven PA focus negatively impacted PA engagement. Research has suggested that PA interventions may be more successful without incorporating weight-based targets.[38,39] PA also independently reduces the risk of Type 2 Diabetes along with other psychosocial benefits.[40–43] Emphasising the benefits of PA beyond weight-loss or weight management might therefore be useful for promoting sustained PA engagement.

Health interventions after Gestational Diabetes should be initiated as soon as possible after birth for effectiveness, due to the higher risk of Type 2 Diabetes in the first six years after delivery.[44–47] Maindal et al., proposed starting an initiative at 3-months postnatally based on results from reviewing the outcomes of trial data.[47] However, the acceptability of the best timing for diabetes prevention initiatives remains unclear.[17,48–51] Our results suggest 'Recovering from birth' could be impacted by the birth experience, where it takes time to build the stamina required for any movement, especially purposeful or more intense exercise. The risk of fetal macrosomia (larger than average) and subsequent traumatic birth can be increased with a Gestational Diabetes diagnosis.[52,53] The risk of postpartum depression is also increased by 59% with a Gestational Diabetes diagnosis.[54] Therefore, if recovering mentally and physically after birth takes longer after Gestational Diabetes, targeting PA this early may not be effective for all women. Participants in the present study highlighted the importance of opportunities to engage with PA when children are older, for example over 2 years old, and not only at the initial postpartum period, and desired programmes beyond the current 'exercise with baby' opportunities. It is important for women to receive adequate support postnatally to recover from the mental and physical impact of more difficult or traumatic births before targeting PA behaviours. Support could also be underpinned by behaviour change theories and techniques to consider differing motivations and readiness to engage with PA. PA opportunities should also exist for women with previous Gestational Diabetes over an extended period of time to enable them to engage when such support has enabled them to feel sufficiently 'ready' for PA.

4.2 | Social

One of the key barriers identified in this study was the lack of support to engage with PA postnatally, which was compounded depending on the quality of pregnancy advice and interactions with HCPs. Feeling unsupported can happen to any postnatal woman and is not specific to women with previous Gestational Diabetes.[55] However, as with our participants, women with previous Gestational Diabetes in other studies have described wanting more support to engage in varying lifestyle behaviours postnatally.[56] More postnatal support could be needed due to stricter and less transferable behaviours initiated in pregnancy (e.g., walking after meals for acute blood glucose control[57]). Participants also highlighted a heavier dietary or weight-management focus to reduce Type 2 Diabetes risk, suggesting a need for more PA-specific postnatal advice and support from these professionals.

As in previous research, this study identified that 'role as a mother' could facilitate PA when participants wanted to role model PA as positive, but it was also largely a barrier when children's needs were prioritised ahead of individual time for PA.[17,18] Support in the form of coaching or counselling could be helpful for overcoming any guilt experienced by mothers when trying to prioritise themselves.[58] Health coaching has also previously been shown to aid behaviour change in the management of, for example diabetes.[59] Lifestyle coaches have previously been shown to be beneficial for tailoring PA and supporting women to be active after Gestational Diabetes. However, this varied between individuals, with some women feeling suggestions and accommodations were not helpful or relevant for their circumstances.[60] Effective coaching and counselling support should therefore be tailored to individual circumstances and consider diversity and inclusivity. Family-based PA interventions could also potentially overcome the 'role as a mother' barrier for some women, embedding PA as a part of that social role rather than separate to it, and reducing the need for them to 'choose' between time alone or with family.[18,47] Further research is needed to determine the appropriate timing and acceptability of different types of family-based PA interventions and understand for whom these might work.

4.3 | Organisational/community

Workplace initiatives may be helpful for working mothers with Gestational Diabetes who spend a considerable amount of time at work.[62] However, many participants in this study were unable to make use of workplace initiatives due to childcare responsibilities (e.g., condensing working hours), which was also highlighted during the COVID-19 pandemic.[63] Therefore, workplace initiatives need to be improved to incorporate additional measures such as appropriate childcare provision or protected time during condensed working hours to participate.

For participants in this study, childcare outside of working hours was informal, such as partner support or nearby family. Some participants were single mums and for others, partner support was not feasible. Therefore, while including partners in PA initiatives could be important,[17,55] it may still not be helpful for many women after Gestational Diabetes and childcare support provided by other organisations could address this barrier. Co-locating childcare opportunities within PA spaces could be helpful, although participants in the present study highlighted that such spaces would need to be perceived as beneficial for their children. Co-designing co-located spaces with mothers could optimise the uptake and use of such spaces.

Access to PA, whether due to location or cost, was a notable barrier in the present study. These barriers are common to PA for the general population; however, specific to women with young families, they were compounded by the desire to prioritise spending on children's enrichment activities over adult-specific PA. The WHO's global action plan encourages the use of community-based initiatives in public spaces to increase affordability and access to PA.[64] Such initiatives could align well with the facilitators in the present study, including walkability of the environment, practical and flexible access to PA. Community-based groups also represent opportunities to connect women with previous Gestational Diabetes, encouraging a sense of community and relatability which could be built on to encourage PA.[65] Group-based PA could be helpful for those women who express a preference for that format (not all do), and PA can be equitably promoted through community-based approaches.[66] Further research is required to understand what community-based approaches exist that women with previous Gestational Diabetes could be eligible for and how to direct and encourage women to access these resources.

4.4 | Strengths and limitations

Using the SEM to organise barriers and facilitators to PA after Gestational Diabetes according to frame, intrapersonal social, organisational and community system levels provides a useful lens for considering how to tackle these factors when aiming to increase engagement with PA after Gestational Diabetes.

Participants were well-spread in terms of their socioeconomic backgrounds; however, were all highly educated. This could have been influenced by the recruitment approach. However, participants were not all highly active, which can be a common bias in research exploring PA perceptions. Despite being highly educated and from less deprived areas than women invited to interview, costs were still a barrier to participants, highlighting that resources may still not be available for this group of women. Participants also predominantly self-identified as White British; therefore, findings may not be generalisable to all ethnic groups. This is important to consider given that women with South Asian heritage are twice as likely to develop Gestational Diabetes and have a subsequent higher risk of progression to Type 2 Diabetes.[67,68] Future research should aim to explore the barriers and facilitators of PA for women from different ethnic backgrounds. This could involve removing the eligibility criteria of being able to communicate in English and working with interpreters to increase participation.

Participants in the present study experienced some of their pregnancy and early postpartum periods during the COVID-19 pandemic, and thus some of their experiences may have been influenced by, for example periods of lockdown, which may be different for pregnant women 'post-pandemic'.[69] As these evolving contextual factors surrounding access to services and service provision continue to change, i.e., remote appointments, hybrid working they must be considered for their impact on PA access going forward.

5 | CONCLUSIONS

Use of the SEM highlighted that most amenable barriers and facilitators to PA were beyond the intrapersonal level, based at higher levels of the SEM (social, organisational and community). A range of interventions, or multi-level interventions are needed to effectively address these barriers. Improving postnatal support and HCP contact are social and organisational-level targets. Access to flexible, cost-effective PA and childcare opportunities is important for PA engagement and should therefore be addressed and targeted accordingly, for example through co-locating childcare with PA opportunities and within workplace initiatives. Directing women to community-based PA resources could also provide the support needed to engage with PA, and overcome cost and access barriers to PA.

AUTHOR CONTRIBUTION

All authors were involved in the discussion of and formulation of the research questions addressed. Elysa Ioannou performed the one-to-one interviews and data collection. Analysis plans and results were discussed and decided by all authors. Helen Humphreys and Elysa Ioannou did the initial coding, with themes generated iteratively in team meetings with Catherine Homer. Elysa Ioannou prepared the original draft manuscript. All authors read, edited and approved the final manuscript. Helen Humphreys, Catherine Homer and Alison Purvis are the lead author's (Elysa Ioannou) supervisors and aided the whole process.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflicts of interest.

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REFERENCES

1. WHO. Diagnostic criteria and classification of hyperglycaemia first detected in pregnancy: a World Health Organization guideline. *Diabetes Res Clin Pract*. 2014;103:341-363. doi:10.1016/j.diabres.2013.10.012
2. IDF. United Kingdom diabetes report 2000 — 2045. 10th edition IDF Diabetes Atlas. Published 2021. Accessed March 9, 2023. https://diabetesatlas.org/data/en/country/209/gb.html
3. Metzger BE. International Association of Diabetes and Pregnancy Study Groups recommendations on the diagnosis and classification of hyperglycemia in pregnancy. *Diabetes Care*. 2010;33(3):676-682. doi:10.2337/dc09-1848
4. DIABETES UK. Cost of diabetes. Cost of Diabetes Guides and Information Published January 25, 2023. Accessed September 13, 2023 https://www.diabetes.co.uk/cost-of-diabetes.html
5. Kalra S, Jena BN, Yeravdekar R. Emotional and psychological needs of people with diabetes. *Indian J Endocrinol Metab*. 2018;22(5):696-704. doi:10.4103/IJEM.IJEM_579_17
6. Ducat L, Philipson LH, Anderson BJ. The mental health comorbidities of diabetes. *Jama*. 2014;312(7):691-692. doi:10.1001/JAMA.2014.8040
7. Vounzoulaki E, Khunti K, Abner SC, Tan BK, Davies MJ, Gillies CL. Progression to type 2 diabetes in women with a known history of gestational diabetes: systematic review and meta-analysis. *BMJ*. 2020;369:m1361. doi:10.1136/bmj.m1361
8. Ayman G, Strachan JA, McLennan N, et al. The top ten research priorities in diabetes and pregnancy according to women, support networks and healthcare professionals. *Diabet Med*. 2021;00:14588. doi:10.1111/dme.14588
9. Knowler W, Barrett-Connor E, Fowler S, et al. Reduction in the incidence of type 2 diabetes with lifestyle intervention or metformin. *N Engl J Med*. 2002;346(6):393-403. doi:10.1056/NEJMoa012512
10. Tuomilehto J, Lindström J, Eriksson JG, et al. Prevention of type 2 diabetes mellitus by changes in lifestyle among subjects with impaired glucose tolerance. *N Engl J Med*. 2001;344(18):1343-1350. doi:10.1056/nejm200105033441801
11. Pan XR, Li GW, Hu YH, et al. Effects of diet and exercise in preventing NIDDM in people with impaired glucose tolerance: the Da Qing IGT and diabetes study. *Diabetes Care*. 1997;20(4):537-544. doi:10.2337/diacare.20.4.537
12. Bao W, Tobias DK, Bowers K, et al. Physical activity and sedentary behaviors associated with risk of progression from gestational diabetes mellitus to type 2 diabetes mellitus: a prospective cohort study. *JAMA Intern Med*. 2014;174(7):1047-1055. doi:10.1001/jamainternmed.2014.1795
13. Engberg E. Physical activity, pregnancy and mental well-being: focusing on women at risk for gestational diabetes. University of Helsinki, 2018.
14. Pereira MA, Rifas-Shiman SL, Kleinman KP, Rich-Edwards JW, Peterson KE, Gillman MW. Predictors of change in physical activity during and after pregnancy: project viva. *Am J Prev Med*. 2007;32(4):312-319. doi:10.1016/J.AMEPRE.2006.12.017
15. Jones EJ, Fraley HE, Mazzawi J. Appreciating recent motherhood and culture: a systematic review of multimodal postpartum lifestyle interventions to reduce diabetes risk in women with prior gestational diabetes. *Matern Child Health J*. 2017;21(1):45-57. doi:10.1007/s10995-016-2092-z
16. Siew L, Mingling C, Makama M, O'Reilly S. Preventing type 2 diabetes in women with previous gestational diabetes: reviewing the implementation gaps for health behavior change programs. *Semin Reprod Med*. 2021;38:377-383. doi:10.1055/s-0040-1722315
17. Dennison RA, Ward RJ, Griffin SJ, Usher-Smith JA. Women's views on lifestyle changes to reduce the risk of developing type 2 diabetes after gestational diabetes: a systematic review, qualitative synthesis and recommendations for practice. *Diabet Med*. 2019;36(6):702-717. doi:10.1111/dme.13926
18. Ioannou E, Humphreys H, Homer C, Purvis A. Systematic review and thematic synthesis of the barriers and facilitators to physical activity for women after gestational diabetes: a socio-ecological approach. *Br J Diab*. 2023;23(1):2-13. doi:10.15277/bjd.2023.413
19. Doran F. Gestational diabetes mellitus: perspectives on lifestyle changes during pregnancy and post- partum, physical activity and the prevention of future type 2 diabetes. *Aust J Prim Health*. 2008;13(3):85-92.
20. Graco M, Garrard J, Jasper AE. Participation in physical activity: perceptions of women with a previous history of gestational diabetes mellitus. *Health Promot J Austr*. 2009;20(1):20-25. doi:10.1071/HE09020

21. Breinholm J, Jakobsen S, Brodersen JS, Sheikh ZA, Nielsen KK. Perception of and motivation for physical activity among women with a history of gestational diabetes. *Women Ther*. 2021;1(2):109-119. doi:10.3390/WOMEN1020010
22. Chater N, Loewenstein G. The i-frame and the s-frame: how focusing on individual-level solutions has led behavioral public policy astray. *Behav Brain Sci*. 2022;46:e147. doi:10.1017/S0140525X22002023
23. Mcleroy KR, Bibeau D, Steckler A, Glanz K. An ecological perspective on health promotion programs. *Health Educ Behav*. 1988;15(4):351-377. doi:10.1177/109019818801500401
24. Stokols D. Translating social ecological theory into guidelines for community health promotion. *Am J Health Promot*. 1996;10(4):282-298. doi:10.4278/0890-1171-10.4.282
25. O'Brien BC, Harris IB, Beckman TJ, Reed DA, Cook DA. Standards for reporting qualitative research: a synthesis of recommendations. *Acad Med*. 2014;89(9):1245-1251. doi:10.1097/ACM.0000000000000388
26. PHE. Local Authority Health Profile 2018. 2018 https://democracy.sheffield.gov.uk/documents/s32505/
27. ONS. How life has changed in Sheffield: Census 2021. Published. 2021. Accessed July 21, 2023 https://www.ons.gov.uk/visualisations/censusareachanges/E08000019/
28. Braun V, Clarke V. To saturate or not to saturate? Questioning data saturation as a useful concept for thematic analysis and sample-size rationales. *Qual Res Sport Exerc Health*. 2021;13(2):201-216. doi:10.1080/2159676X.2019.1704846
29. Saunders B, Sim J, Kingstone T, et al. Saturation in qualitative research: exploring its conceptualization and operationalization. *Qual Quant*. 2018;52(4):1893-1907. doi:10.1007/S11135-017-0574-8
30. Braun V, Clarke V, Weate P. Using thematic analysis in sport and exercise research. In: Smith B, Brett M, Sparkes AC, eds. *Routledge Handbook of Qualitative Research in Sport and Exercise. Routledge International Handbooks*. Routledge; 2019:191-206.
31. Byrne D. A worked example of Braun and Clarke's approach to reflexive thematic analysis. *Qual Quant*. 2022;56(3):1391-1412. doi:10.1007/S11135-021-01182-Y/FIGURES/D
32. Braun V, Clarke V. Reflecting on Reflexive Thematic Analysis. *Qualita Res Sport Excer Heath*. 2019;11(4):589-597. doi:10.1080/2159676X.2019.1628806
33. Adler RH. Trustworthiness in qualitative research. *J Hum Lact*. 2022;38(4):598-602. doi:10.1177/08903344221116620/ASSET/08903344221116620.FP.PNG_V03
34. Dodgson JE. Reflexivity in qualitative research. *J Hum Lact*. 2019;35(2):220-222. doi:10.1177/0890334419830990
35. Clark A. Exploring Women's experiences: embodied pathways and influences for exercise participation. *Soc Forces*. 2019;9(1):16. doi:10.3390/SOC9010016
36. Prichard I, Tiggemann M. Relations among exercise type, self-objectification, and body image in the fitness centre environment: the role of reasons for exercise. *Psychol Sport Exerc*. 2008;9(6):855-866. doi:10.1016/J.PSYCHSPORT.2007.10.005
37. Folk AL, Hooper L, Hazzard VM, Larson N, Barr-Anderson DJ, Neumark-Sztainer D. Does weight-motivation for exercise predict physical activity levels across the life course from adolescence to adulthood? *J Adolesc Health*. 2022;71(1):112-118. doi:10.1016/J.JADOHEALTH.2022.02.002
38. Ratner RE, Christophi CA, Metzger BE, et al. Prevention of diabetes in women with a history of gestational diabetes: effects of metformin and lifestyle interventions. *J Clin Endocrinol Metab*. 2008;93(12):4774-4779. doi:10.1210/JC.2008-0772
39. Gilinsky AS, Dale H, Robinson C, Hughes AR, McInnes R, Lavallee D. Efficacy of Physical Activity Interventions in Post-Natal Populations: Systematic Review, Meta-Analysis and Content Coding of Behaviour Change Techniques. *Health Psychol Rev*. 2014;9(2):244-263. doi:10.1080/17437199.2014.899059
40. Colberg SR, Sigal RJ, Yardley JE, et al. Physical activity/exercise and diabetes: a position statement of the American Diabetes Association. *Diabetes Care*. 2016;39(11):2065-2079. doi:10.2337/DC16-1728
41. Colberg SR, Sigal RJ, Fernhall BO, et al. Exercise and type 2 diabetes. *Diabetes Care*. 2010;33:e147-e167. doi:10.2337/dc10-9990
42. Hamasaki H. Daily physical activity and type 2 diabetes: a review. *World J Diabetes*. 2016;7(12):243. doi:10.4239/WJD.V7.I12.243
43. Laaksonen DE, Lindström J, Lakka TA, et al. Physical activity in the prevention of type 2 diabetes: the Finnish diabetes prevention study. *Diabetes*. 2005;54(1):158-165. doi:10.2337/DIABETES.54.1.158
44. Dennison RA, Chen ES, Green ME, et al. The absolute and relative risk of type 2 diabetes after gestational diabetes: a systematic review and meta-analysis of 129 studies. *Diabetes Res Clin Pract*. 2021;171:108625. doi:10.1016/j.diabres.2020.108625
45. Song C, Lyu Y, Li C, et al. Long-term risk of diabetes in women at varying durations after gestational diabetes: a systematic review and meta-analysis with more than 2 million women. *Obes Rev*. 2018;19(3):421-429. doi:10.1111/obr.12645
46. Pedersen ALW, Terkildsen Maindal H, Juul L. How to prevent type 2 diabetes in women with previous gestational diabetes? A systematic review of behavioural interventions. *Prim Care Diabetes*. 2017;11(5):403-413. doi:10.1016/J.PCD.2017.05.002
47. Maindal HT, Timm A, Dahl-Petersen IK, et al. Systematically developing a family-based health promotion intervention for women with prior gestational diabetes based on evidence, theory and co-production: the face-it study. *BMC Public Health*. 2021;21(1):1-14. doi:10.1186/S12889-021-11655-2/TABLES/1
48. Lie MLSS, Hayes L, Lewis-Barned NJ, May C, White M, Bell R. Preventing type 2 diabetes after gestational diabetes: women's experiences and implications for diabetes prevention interventions. *Diabet Med*. 2013;30(8):986-993. doi:10.1111/dme.12206
49. Parsons J, Sparrow K, Ismail K, Hunt K, Rogers H, Forbes A. A qualitative study exploring women's health behaviours after a pregnancy with gestational diabetes to inform the development of a diabetes prevention strategy. *Diabet Med*. 2019;36(2):203-213. doi:10.1111/dme.13794
50. Jones EJ, Peercy M, Woods JC, et al. Identifying postpartum intervention approaches to reduce cardiometabolic risk among American Indian women with prior gestational diabetes, Oklahoma, 2012–2013. *Prev Chronic Dis*. 2015;12:E45. doi:10.5888/pcd12.140566
51. Dasgupta K, Da Costa D, Pillay S, et al. Strategies to optimize participation in diabetes prevention programs following gestational diabetes: a focus group study. *PloS One*. 2013;8(7):e67878. doi:10.1371/journal.pone.0067878
52. Kc K, Shakya S, Zhang H. Gestational diabetes mellitus and macrosomia: a literature review. *Ann Nutr Metab*. 2015;66(Suppl 2):14-20. doi:10.1159/000371628

53. Turkmen S, Johansson S, Dahmoun M. Foetal macrosomia and Foetal-maternal outcomes at birth. *J Pregnancy*. 2018;2018:1-9. doi:10.1155/2018/4790136
54. Azami M, Badfar G, Soleymani A, Rahmati S. The association between gestational diabetes and postpartum depression: a systematic review and meta-analysis. *Diabetes Res Clin Pract*. 2019;149:147-155. doi:10.1016/J.DIABRES.2019.01.034
55. Makama M, Awoke MA, Skouteris H, Moran LJ, Lim S. Barriers and facilitators to a healthy lifestyle in postpartum women: a systematic review of qualitative and quantitative studies in postpartum women and healthcare providers. *Obes Rev*. 2021;22(4):e13167. doi:10.1111/OBR.13167
56. Dennison RA, Griffin SJ, Usher-Smith JA, Fox RA, Aiken CE, Meek CL. "Post-GDM support would be really good for mothers": a qualitative interview study exploring how to support a healthy diet and physical activity after gestational diabetes. *PloS One*. 2022;17(1):e0262852. doi:10.1371/journal.pone.0262852
57. NICE. Diabetes in pregnancy: management from preconception to the postnatal period. Published 2020. Accessed November 30, 2022. https://www.nice.org.uk/guidance/ng3/chapter/Recommendations#postnatal-care
58. O'Reilly SL. Prevention of diabetes after gestational diabetes: better translation of nutrition and lifestyle messages needed. *Healthcare (Basel)*. 2014;2(4):468-491. doi:10.3390/healthcare2040468
59. Lindner H, Menzies D, Kelly J, Taylor S, Shearer M. Coaching for behaviour change in chronic disease: a review of the literature and the implications for coaching as a self-management intervention. *Aust J Prim Health*. 2003;9(2–3):177-185. doi:10.1071/PY03044
60. Horn CE, Seely EW, Levkoff SE, Isley BC, Nicklas JM. Postpartum women's experiences in a randomized controlled trial of a web-based lifestyle intervention following gestational diabetes: a qualitative study. *Randomized Controll Trial*. 2023;36(1):2194012. doi:10.1080/14767058.2023.2194012
61. Timm A, Dahl-Petersen IK, et al. Systematically developing a family-based health promotion intervention for women with prior gestational diabetes based on evidence, theory and co-production: the face-it study. *BMC Public Health*.
62. Buckingham SA, Williams AJ, Morrissey K, Price L, Harrison J. Mobile health interventions to promote physical activity and reduce sedentary behaviour in the workplace: a systematic review. *Digit Health*. 2019;5. doi:10.1177/2055207619839883
63. GOV. Parenting in lockdown: Coronavirus and the effects on work-life balance–Office for National Statistics. Coronavirus (COVID-19). Published July 22, 2020. Accessed July 21, 2023. https://www.ons.gov.uk/peoplepopulationandcommunity/healthandsocialcare/conditionsanddiseases/articles/parentinginlockdowncoronavirusandtheeffectsonworklifebalance/2020-07-2261
64. WHO. *Global Action Plan on Physical Activity 2018–2030: More Active People for a Healthier World*. 2018.
65. Peralta LR, Cotton WG, Dudley DA, Hardy LL, Yager Z, Prichard I. Group-based physical activity interventions for postpartum women with children aged 0-5 years old: a systematic review of randomized controlled trials. *BMC Womens Health*. 2021;21(1):1-16. doi:10.1186/s12905-021-01581-1
66. Kohler S, Dippon L, Helsper N, et al. Population-based physical activity promotion with a focus on health equity: a review of reviews. *Int J Equity Health*. 2023;22(1):1-13. doi:10.1186/S12939-023-01834-5/TABLES/1
67. Gadve SS, Chavanda S, Mukherjee AD, Aziz S, Joshi A, Patwardhan M. Risk of developing type 2 diabetes mellitus in south Asian women with history of gestational diabetes mellitus: a systematic review and meta-analysis. *Indian J Endocrinol Metab*. 2021;25(3):176-181. doi:10.4103/ijem.IJEM_57_21
68. Lamri A, Limbachia J, Schulze KM, et al. The genetic risk of gestational diabetes in south Asian women. *Geneti Genomi*. 2022;11:11. doi:10.7554/ELIFE.81498
69. Royal College of Obstetricians and Gynaecologists. Guidance for maternal medicine services in the coronavirus (COVID-19) pandemic. 2020; 1–44.

SUPPORTING INFORMATION

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

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