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Understanding physical activity participation among underserved women: a mixed-methods cross sectional study using an ecological framework

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Abstract

Background Physical inactivity remains a major contributor to non-communicable diseases and health inequalities in the UK, particularly among underserved women living in socioeconomically deprived areas. In post-industrial port communities across Suffolk and Norfolk such as Ipswich, Lowestoft, Great Yarmouth, and Felixstowe, women face intersecting barriers to physical activity (PA), including gender norms, ethnicity, chronic illness, caregiving duties, and limited access to affordable, culturally appropriate PA opportunities. This study addresses a critical evidence gap by exploring multi-level influences on PA engagement among these populations using an ecological and intersectional lens.

Methods A convergent parallel mixed-methods design was employed, guided by Bronfenbrenner's Ecological Systems Theory. Quantitative data were collected using the International Physical Activity Questionnaire-Short Form (IPAQ-SF) and the Exercise Benefits and Barriers Scale (EBBS), administered to 112 women aged 18–65 recruited from community-based PA and weight-loss programmes. Embedded within the survey were open-ended prompts capturing lived experiences. Data were analysed using SPSS v29 for t-tests, chi-square tests, and logistic regression, while qualitative data underwent thematic analysis using NVivo 14. Findings were integrated across five ecological levels: microsystem, mesosystem, exosystem, macrosystem, and chronosystem.

Results Only 58% of participants met recommended PA guidelines. Key barriers included chronic health conditions (Odds Ratio (OR) = 0.50), caregiving responsibilities (OR = 0.56), low self-confidence (OR = 0.49), and cost (OR = 0.59). Qualitative findings revealed intersecting challenges, such as cultural expectations, modesty norms, family criticism, lack of safe infrastructure, and inconsistent PA programme availability. Divergences between high EBBS benefit scores and narratives of demotivation highlighted emotional dissonance and structural constraints. Temporal factors like motherhood, menopause, and community service cuts also disrupted sustained engagement.

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Conclusion Women's PA behaviours in these areas are shaped by a complex interplay of individual, social, structural, cultural, and temporal factors. One-size-fits-all behavioural messaging is insufficient. Effective interventions must be inclusive, culturally sensitive, and rooted in local realities. This study offers a robust foundation for designing equity-focused, multi-level strategies to promote PA in underserved communities.

Keywords Physical activity, Underserved women, Ecological systems theory, Coastal communities, Health inequalities, Mixed methods, Structural barriers

Background

Physical inactivity is widely recognised as one of the most significant modifiable risk factors contributing to global morbidity and premature mortality [1–4]. It plays a central role in the development of non-communicable diseases (NCDs), including cardiovascular disease, obesity, type 2 diabetes, and certain cancers. In the United Kingdom (UK), physical inactivity is estimated to contribute to one in six deaths and costs the National Health Service (NHS) over £1 billion annually [4, 5]. In response, the UK Chief Medical Officers (CMO) recommend that adults engage in at least 150 min of moderate-intensity aerobic physical activity (PA) per week, along with muscle-strengthening activities on two or more days [5]. Despite this guidance, a significant proportion of the UK population fails to meet these recommendations, with stark disparities in PA engagement across gender, ethnicity, and socioeconomic status [6–8].

Women, especially those living in socioeconomically deprived areas, consistently report lower levels of PA compared to men [2, 6]. These disparities are even more pronounced among women from racially and ethnically minoritised backgrounds, particularly Black African, Caribbean, and South Asian communities [9, 10]. Such groups encounter a complex intersection of cultural, social, and economic barriers, including time constraints due to caregiving responsibilities, limited self-confidence, religious restrictions around modesty, fear of judgement in public settings, and a lack of culturally appropriate exercise spaces [11, 12]. Despite national attention to these inequalities, public health strategies have struggled to account for or meaningfully engage with the lived experiences of these women.

These challenges are particularly evident in underserved coastal port towns across Suffolk and Norfolk, such as Ipswich, Lowestoft, Great Yarmouth, and Felixstowe. These post-industrial communities, much like Barrow-in-Furness in the North West or Hartlepool in the North East, have experienced prolonged structural decline, economic disinvestment, and public health neglect [13, 14]. Once vital hubs of maritime trade, many of these towns now face high unemployment, low household incomes, limited access to health-promoting infrastructure, and worsening health indicators [14, 15]. The availability and accessibility of PA facilities, including leisure centres, green spaces, walking routes, and gyms, are often inadequate, poorly maintained, or inaccessible to residents without private transport [15, 16].

In this context, women in these towns face a "double burden" of structural exclusion and gendered expectations [17]. Time poverty, economic insecurity, and unpaid caregiving responsibilities make PA a low priority [10]. Additionally, concerns about personal safety, limited social support, and lack of affordable or culturally sensitive PA options further limit participation, especially among women from Muslim backgrounds or other minoritised groups [18, 19].

While public health efforts, such as Together an Active Future (TAAF), Active Suffolk, and Sport England's *Uniting the Movement* strategy, aim to promote inclusive PA engagement, they often rely on standardised messaging that may lack resonance in these areas. Campaigns encouraging people to "move more" or commit to "just 30 minutes a day" may inadvertently amplify feelings of guilt or exclusion among those facing real structural constraints [20–22]. Furthermore, these strategies tend to favour behavioural framing over contextual insight, limiting their ability to catalyse lasting change.

A critical shortcoming in existing research and policy is the reliance on aggregated population-level data, which often obscures the nuances of underserved communities. For example, the *Active Lives Adult Survey* (2023) reports that 61% of women in England meet the CMO's PA guidelines. However, such statistics mask disparities within sub-populations, particularly among women in deprived coastal port towns or from Black and Asian backgrounds where participation remains significantly lower. Without disaggregated, place-sensitive evidence, policy responses may fail to reach those most in need.

In contrast, locally rooted, community engaged studies have demonstrated that when PA interventions are co-designed with residents and grounded in real-world experiences, they are more likely to yield sustained engagement and impact [23, 24]. However, there remains a dearth of UK-based research that integrates ecological and intersectional perspectives to examine how various factors including individual, social, cultural, economic, and environmental influences interact to affect women's PA behaviour in port communities.

Temporal influences such as life-stage transitions for example, menopause or caregiving and community level changes for example, funding cuts or programme

closures are also underexamined. These chronosystem-level dynamics play a crucial role in shaping whether and how women sustain PA over time. Studies by Parnell et al., [25] and Densley et al., [26] highlight the need to move beyond short term interventions by incorporating life-course and systemic temporal factors into PA research and design.

Moreover, although healthcare professionals are frequently positioned as key influencers of PA behaviour, their role in supporting long-term engagement among underserved women is underexplored. Research indicates that brief, generalised, or culturally insensitive advice may have limited impact, especially in the absence of follow-up, practical support, or culturally congruent approaches [27–29].

This study contributes to addressing these gaps by focusing on the lived experiences of underserved women in coastal port towns across Suffolk and Norfolk. The term *underserved* in this context refers to women who face overlapping economic, cultural, and geographical disadvantages that restrict their access to health-promoting resources and opportunities for physical activity. These include women living in areas of socioeconomic deprivation, from racially and ethnically minoritised backgrounds, and those experiencing exclusion due to gendered roles or place-based barriers.

Rather than aiming to generalise to all women in these areas, this study foregrounds the voices of women already attending or considering PA and weight loss programmes. These participants offer valuable insights into both the barriers and enablers of engagement from a standpoint of partial participation or recent motivation to become active. While not representative of all women in port communities, their perspectives provide a vital entry point for understanding the structural, interpersonal, and psychological forces at play even among those with relatively high motivation.

To frame the enquiry, Bronfenbrenner's Ecological Systems Theory is adopted as a guiding framework [30]. This approach facilitates an exploration of how multiple, interlocking layers, ranging from individual beliefs to macro-level policy environments, converge to shape women's opportunities, decisions, and experiences around physical activity.

In light of the above, the present study seeks to explore the complex, intersecting, and multi-layered influences on PA participation among underserved women in Suffolk and Norfolk's port communities. The research aims to generate insight that can inform the development of equitable, contextually grounded, and culturally responsive interventions that address both proximal and systemic barriers to PA.

Research aim

This project aims to investigate the complex, multi-layered influences on PA participation among underserved women living in coastal port communities across Suffolk and Norfolk. Drawing on Bronfenbrenner's Ecological Systems Theory, the research explores how individual, relational, structural, cultural, and temporal factors interact across ecological levels to shape women's perceptions, behaviours, and lived experiences of engaging in PA.

Research objectives

To achieve this aim, the study will:

1) Identify and categorise the barriers and enablers to PA participation across the five ecological levels proposed by Bronfenbrenner, integrating quantitative survey data with qualitative thematic analysis.
2) Examine how individual attributes and interpersonal dynamics influence women's attitudes, confidence, and behaviours around PA within the microsystem and mesosystem.
3) Investigate how women perceive the availability, accessibility, and effectiveness of institutional and community support within the mesosystem and exosystem and how this support influences their ability to engage in PA.
4) Explore how life-course transitions, such as caregiving responsibilities or menopause, and broader community-level changes, such as the closure of PA services, impact sustained PA participation over time.
5) Generate theory-informed, context-sensitive evidence to inform the co-design of equitable, multi-level interventions that address the specific needs and realities of underserved women.

Methods

Theoretical framework: Bronfenbrenner's ecological systems theory

Bronfenbrenner's Ecological Systems Theory [31] was adopted as the guiding theoretical framework for this study. Originally developed to understand child development, this theory has since been widely applied in public health and behavioural sciences to explore how health-related behaviours are shaped by multiple, interdependent layers of influence within the broader environment [1]. The theory outlines five key systems: microsystem, mesosystem, exosystem, macrosystem and chronosystem, which collectively illustrate how individuals are embedded within, and influenced by, a series of overlapping social and structural contexts.

In line with this tradition, the present study applies Bronfenbrenner's ecological systems theory to investigate the multi-layered determinants of PA participation

among underserved women in post-industrial coastal communities. The framework allows for the classification of barriers and enablers at various levels of influence. The microsystem includes individual-level attributes such as confidence, health beliefs and familial interactions. The mesosystem reflects interactions between settings such as home and community physical activity programmes. The exosystem considers institutional, economic and infrastructural factors. The macrosystem encompasses broader cultural norms and policy environments. The chronosystem captures life transitions and systemic shifts over time, such as menopause or community service reductions[32–34].

This theoretical model is especially useful in exploring the complexity of underserved women's PA engagement by recognising that behaviours are not shaped by individual factors alone but emerge through dynamic interactions with broader societal and temporal forces. By mapping both qualitative and quantitative data onto this ecological structure, the study offers a theoretically grounded approach to understanding the context-specific and systemic influences that shape women's opportunities and decisions around PA.

We thus conceive that women's participation in PA is socially situated and influenced by a constellation of individual, relational, structural, cultural and temporal factors. Their experiences are not reducible to personal motivation alone but are embedded within a wider ecology of disadvantage that includes community resources, sociocultural expectations, institutional accessibility and policy environments.

Research design

A convergent parallel mixed-methods design was employed in this study. This design allowed for simultaneous collection and analysis of qualitative and quantitative data, ensuring both breadth and depth in addressing the study's research questions [35]. The design was underpinned by a pragmatist paradigm, which prioritises methodological flexibility and real world applicability over adherence to a single epistemological position [36].

The integration of data occurred at both the design and interpretative levels. Quantitative data from structured surveys provided generalisable insights into PA behaviours and access to resources, while qualitative data captured rich, experiential detail around barriers and motivators. These data were collected concurrently, analysed separately, and integrated during interpretation to produce ecologically grounded themes and categories.

The mixed methods approach strengthened the exploration of participants' experiences and enabled researchers to quantify key trends and relationships, creating a comprehensive analysis framework for validation through larger-scale quantitative measures [37]. This approach was also selected to support the application of Bronfenbrenner's Ecological Systems Theory, enabling data to be mapped across ecological levels and facilitating integrated analysis of individual, interpersonal, structural, and temporal influences on PA engagement.

Setting, recruitment, and sample composition

Participants were women residing in several post-industrial coastal communities across Suffolk and Norfolk, specifically Ipswich, Lowestoft, Great Yarmouth, and Felixstowe. These towns are characterised by persistent socioeconomic deprivation, historical underinvestment, and limited access to health-promoting infrastructure, as described in the background section. Although participants were recruited through local community based PA and weight loss programmes, eligibility was contingent upon current residency in one of the target communities. This ensured that participants were embedded within the local social and environmental context, allowing the study to capture lived experiences of PA engagement within the realities of their everyday lives.

A purposive sampling approach was used to recruit adult women aged 18 to 65 years (mean = 41.3, SD = 11.6) [38]. Eligibility criteria included: (1) proficiency in English, (2) the ability to provide informed consent, and (3) current enrolment in, or intention to participate in, a local PA or weight-loss initiative. This focus on participants who were actively or prospectively engaged with PA enabled the study to explore both entrenched and emerging influences on physical activity behaviour.

Recruitment was conducted through a variety of initiatives delivered by local authorities, community health organisations, and voluntary sector groups. These included walking clubs, group dance sessions, and structured weight loss programmes. Programme leads who were already embedded within these community settings played a key role in facilitating recruitment, which helped build trust and encourage participation among women from minoritised backgrounds. This recruitment strategy ensured participants had first-hand experience with the opportunities and challenges associated with PA in their local areas, reflecting the study's emphasis on lived experience and ecological context.

In addition to purposive sampling, convenience sampling was employed by targeting women already attending these programmes [39]. This was supplemented with outreach sampling to enhance demographic diversity across ethnicity, socioeconomic status, and education level. Community liaisons and trusted health professionals distributed study information and supported the informed consent process, particularly within ethnic minority communities where research participation is

often limited due to language barriers, cultural disconnects, or research fatigue.

The final sample ($n = 112$), as summarised in Table 1, included a disproportionately high number of women identifying as Black African (45%) and South Asian (30%). While this demographic composition does not reflect the broader population profile of Suffolk and Norfolk, it is consistent with two important contextual realities. First, several of the PA and weight-loss programmes from which participants were drawn had targeted or prioritised women from ethnic minority backgrounds, based on Public Health England data identifying these populations as being at greater risk of obesity-related conditions and lower levels of PA engagement [9, 13]. Second, longstanding community relationships with programme facilitators and focused outreach efforts likely enhanced recruitment among these underrepresented groups.

Although the sample is not statistically representative of all women living in Suffolk and Norfolk's port communities, it is analytically robust. The composition of the sample enables a deep exploration of how women living in resource-constrained environments engage with PA, including those who are currently active and those who are in transitional stages of participation. This approach aligns with the study's ecological and intersectional framework, which prioritises depth of insight and contextual understanding over broad generalisability.

Table 1 Participant demographic characteristics ($n = 112$)

Characteristic	Category	Number of Participants (%)
Age	18–29	25 (22.3%)
	30–39	28 (25.0%)
	40–49	21 (18.8%)
	50–59	23 (20.5%)
	60–65	15 (13.4%)
Ethnicity	Black African	50 (44.6%)
	South Asian	34 (30.4%)
	White British	18 (16.1%)
	Others	10 (8.9%)
Marital/relationship status	Married/Partnered	58 (51.8%)
	Single	39 (34.8%)
	Divorced/Widowed	15 (13.4%)
Employment status	Full-time	54 (48.2%)
	Part-time	36 (32.1%)
	Unemployed	12 (10.7%)
	Retired	10 (8.9%)
Education level	College/A-levels or equivalent	28 (25.0%)
	Bachelor's Degree	62 (55.4%)
	Postgraduate Degree	22 (19.6%)
Access to p.a. facilities	Adequate	78 (69.6%)
	Limited	34 (30.4%)
Transportation access	Private vehicle	73 (65.2%)
	Public transport only	39 (34.8%)
Cultural/religious affiliation	Affiliated	76 (67.9%)
	Not affiliated	36 (32.1%)
Chronic health condition	Yes	70 (62.5%)
	No	42 (37.5%)
Meets weekly PA guidelines (≥ 150 min)	Yes	65 (58.0%)
	No	47 (42.0%)

Justification for sample size

The sample size for this study was determined through a dual rationale: statistical power calculations for the quantitative analyses and data saturation principles for qualitative insights. For the quantitative component, an a priori power analysis was conducted using G*Power version 3.1 to ensure that the study achieved adequate power to detect statistically meaningful effects [40, 41]. The analysis was based on a desired power of 80% ($1 - \beta = 0.80$), an alpha level of 0.05, and a moderate effect size ($d = 0.5$), in line with Cohen's guidelines [42]. Based on planned comparisons (t-tests assessing PA levels by demographic subgroups) and multiple logistic regression models (identifying predictors of PA engagement), the power analysis indicated that a minimum sample size of 102 participants would be required to detect statistically significant differences while accounting for relevant confounding variables [43].

To allow for incomplete data or potential dropouts, a 10% oversampling buffer was applied, bringing the final recruitment target to 112 participants. This sample size was deemed sufficient for subgroup comparisons such as between physically active and inactive women, and for multivariate analysis with several covariates. The strength of the regression model was confirmed by an R^2 value of 0.31 in Model 1a, indicating that 31% of the variance in PA engagement was explained by the selected predictors demonstrating good model fit and justifying the adequacy of the sample for inferential analysis [44].

Data collection and instruments

Data collection involved the use of validated instruments and embedded qualitative prompts to capture measurable data as well as participants' experiences, attitudes, and motivations. The self-administered questionnaires were completed online using a secure survey platform to enhance accessibility and participant convenience. Data were collected over a four-month period between September and December 2024, accounting for potential seasonal influences on PA levels. This time frame was intentionally selected to reflect fluctuations in motivation and opportunity influenced by colder weather, reduced daylight hours, and seasonal service disruptions often reported in these towns. To maximise participation from women in digitally underserved areas, local facilitators

also supported digital access where required. Missing data were minimal (< 5%) and managed using listwise deletion in SPSS.

Validity and reliability of instruments

The study utilised the short-form International Physical Activity Questionnaire (IPAQ-SF), a widely used and validated tool for assessing PA levels across populations and contexts [45]. To complement this, the Exercise Benefits and Barriers Scale (EBBS) was employed to measure perceived facilitators and challenges related to PA. The EBBS has demonstrated robust psychometric properties, with internal consistency coefficients ranging from 0.86 to 0.96 [46].

To elicit deeper insights, the survey incorporated four scenario-based and open-ended reflective prompts developed in consultation with local programme facilitators and informed by relevant literature on PA engagement among underserved groups [20, 47]. These prompts were embedded at logical points within the questionnaire, following sections on health status, PA behaviours, and attitudes. One example prompt read: *"Imagine you are considering joining a new exercise group in your community. What factors would encourage or discourage you from participating?"* Participants responded via open-text boxes, offering reflections on personal experiences, barriers, motivators, and the role of support systems.

The open-text prompts were designed to be inclusive and accessible to all participants, enabling the capture of contextualised, real-world insights at scale. Responses were thematically aligned with ecological levels, enabling the subsequent mapping of qualitative data to microsystem, mesosystem, exosystem, macrosystem, and chronosystem themes during analysis.

All survey instruments, including the IPAQ-SF, EBBS, and the full list of qualitative prompts, are provided in the supplementary file for reference.

Ethical considerations

Ethical approval was obtained from the University of Suffolk Research Ethics Committee (reference ID: RETH24/018), in full accordance with the Declaration of Helsinki and the UK General Data Protection Regulation (GDPR). All participants were provided with detailed information outlining the purpose of the study, voluntary participation, the right to withdraw at any time without consequence, and assurances of data confidentiality and anonymity [48]. In consideration of the sensitive nature of some questions, particularly those related to barriers to PA, participants were provided with contact details for support services. These measures helped ensure transparency, ethical integrity, and the welfare of all participants throughout the research process [49].

Data analysis

The data analysis process followed the logic of a convergent parallel mixed methods design, where quantitative and qualitative data were analysed separately and then integrated to provide a comprehensive understanding of PA behaviours. Drawing on Bronfenbrenner's [51] Ecological Systems Theory, findings were mapped across five ecological levels to examine how individual, relational, structural, cultural, and temporal influences intersect.

Quantitative data analysis

Quantitative data derived from the IPAQ-SF and the EBBS were analysed using IBM SPSS Statistics version 29. Descriptive statistics were used to summarise participant characteristics, weekly PA levels, and perceived barriers and benefits to PA engagement [45, 46]. PA was reported as total minutes per week, and categorical comparisons were made between those meeting the CMO's PA recommendations (≥ 150 min/week) and those who did not.

Inferential statistics were applied to examine group differences and predictive relationships. Independent samples t-tests compared EBBS scores across active and inactive subgroups, and chi-square tests assessed associations between categorical variables such as ethnicity, employment status, and PA participation [43]. Multivariable logistic regression modelling was conducted to identify significant predictors of PA engagement (Model 1a) and PA-related information-seeking behaviour (Model 1b), controlling for potential confounders such as age and self-reported health status [41, 43].

All statistical assumptions for regression modelling (multicollinearity, normality of residuals, linearity) were assessed and met. Odds ratios (ORs), 95% confidence intervals (CIs), and Nagelkerke's R^2 were reported to interpret effect sizes and model fit. For example, Model 1a accounted for 31% of the variance in weekly PA engagement, indicating robust explanatory power. Predictors such as chronic health conditions, caregiving responsibilities, and low self-confidence showed statistically significant inverse associations with PA participation. These models were interpreted using guidance from Cohen [42] and aligned with analytical standards for behavioural health research [50].

Qualitative data analysis

The qualitative dataset consisted of open text responses to the four embedded reflective prompts within the online survey. These prompts were designed to elicit personal narratives about experiences, barriers, and motivators related to PA engagement. Thematic analysis followed Braun and Clarke's six-phase framework: familiarisation, generating initial codes, searching for themes, reviewing themes, defining and naming themes, and producing the final report [51].

An inductive-deductive coding approach was employed. Initially, data were open coded line by line to allow themes to emerge directly from the participants' narratives. These were then mapped deductively onto Bronfenbrenner's Ecological Systems Theory to categorise responses across the microsystem, mesosystem, exosystem, macrosystem, and chronosystem levels [30, 32]. For example, the inductive code "*gym discomfort due to stares*" was mapped to the microsystem level under "*body image and self-confidence*." This approach enabled the identification of both emergent themes and theory-aligned influences on behaviour, consistent with ecological and intersectional analysis in health research [33, 34].

NVivo 14 software was used to manage, organise, and retrieve coded data. Coding was performed iteratively by the lead author and independently cross checked by the third author, who double coded approximately 25% of the dataset. Discrepancies were discussed and resolved through reflexive team dialogue. A coding framework was developed and revised in consultation with an experienced qualitative researcher [52, 53]. The full coding framework is supplied in the supplementary file for transparency and reference.

Data saturation was achieved when no new codes or themes emerged after coding approximately 85% of responses. This threshold is supported by previous studies in public health and implementation science [54, 55].

Themes were further validated through constant comparison across participants of different ethnic, socioeconomic, and health backgrounds. This aligns with maximum variation sampling principles [56] and helped capture the depth and diversity of lived experiences, supporting both credibility and transferability of findings [57, 58].

Illustrative examples of key themes, subthemes, and supporting participant quotes are presented in the Results section.

Integrating quantitative and qualitative findings

The integration of quantitative and qualitative data was guided by the principles of a convergent parallel mixed methods design [35]. Data were analysed separately and then merged at the interpretation phase using a side by side comparison technique and joint display matrices [59]. For example, while 45% of survey respondents cited caregiving as a barrier, qualitative narratives highlighted associated guilt, family criticism, and cultural expectations, factors not captured in standardised tools.

Findings were structured around Bronfenbrenner's five ecological levels, which served as an analytical scaffold to align and compare both data types. Convergent themes (chronic illness or transport access) were triangulated to reinforce validity. Divergent findings (high EBBS benefit scores versus scepticism of results in narratives) revealed emotional and contextual nuances missed by quantitative tools.

Visual integration was supported through data displays, including figures and joint tables that presented demographic insights, regression models, and coded participant quotes. This enhanced accessibility and interpretability while maintaining methodological transparency and ecological fidelity.

Rigour

Methodological rigour was maintained through adherence to established quality frameworks for both strands of the mixed methods study. For quantitative data, validated instruments (IPAQ-SF and EBBS) with established psychometric robustness were employed [45, 46]. All statistical analyses were conducted using appropriate tests, with assumptions checked and sensitivity analyses performed as required [50].

For the qualitative strand, inter coder reliability, reflexivity, and triangulation of data sources enhanced analytic depth and authenticity [52]. Direct quotes were used to preserve participants' voices, with particular attention paid to minority and divergent perspectives.

Mixed methods integration enhanced rigour through complementarity and expansion. Each data type added interpretive depth to the other [35]. The use of Bronfenbrenner's theory as an organising framework ensured ecological rigour, aligning with best practice in public health research seeking to capture the multi-level determinants of behaviour in underserved populations [30, 32, 60]. Together, these strategies ensured the study's findings were not only methodologically robust but also socially and contextually grounded.

Results

This section presents an integrated analysis of quantitative and qualitative findings, structured around Bronfenbrenner's Ecological Systems Theory [30]. Results are organised across five interrelated ecological levels microsystem, mesosystem, exosystem, macrosystem, and chronosystem to illuminate the complex, multi-layered influences on women's PA behaviours.

Rather than presenting quantitative and qualitative data in isolation, this integrated approach captures both measurable patterns and the lived experiences that shape PA engagement. Within each ecological level, we identify key themes and subthemes, supported by illustrative participant quotes, relevant statistical outputs, and visual representations. This structure provides a holistic understanding of how individual, social, structural, and cultural dynamics interact to either constrain or support women's participation in PA. Quantitative data such as EBBS scores [46], IPAQ minutes [45], and regression model

results [43, 44] are embedded throughout each level to either reinforce or contrast with qualitative narratives.

Where appropriate, figures and tables are used to visualise the distribution of key barriers and motivations, supporting triangulation of data in accordance with convergent mixed methods design principles [35, 59]. The analytical approach ensures that the emergent themes are mapped clearly to the ecological framework and reflect both statistical trends and narrative depth from the participant responses.

Participant demographics

The study included 112 women aged 18 to 65 years, reflecting a diverse sample across age, ethnicity, employment status, educational background, and health conditions. Table 1 presents the demographic characteristics of participants, providing essential context for interpreting findings across the ecological levels.

These demographic insights are critical to understanding the variability in PA participation. Factors such as age, caregiving responsibilities, employment status, cultural affiliation, and the presence of chronic health conditions significantly shaped women's engagement with PA programmes. Notably, the sample included a high proportion of Black African (45%) and South Asian (30%) women groups often underrepresented in UK based PA research. This representation reflects intentional outreach during recruitment, which was facilitated through partnerships with community organisations. These strategies supported trust building and access to underserved populations.

However, it should be noted that the educational attainment of participants in this sample was relatively high, with over 75% holding a bachelor's or postgraduate degree. This level of education is higher than that observed in the general underserved population in the study areas and may have influenced participants' health literacy, access to information, and engagement behaviours. This demographic characteristic should be considered when interpreting the findings.

Table 2 Microsystem level themes, subthemes, and illustrative quotes

Health and psychological influences	Chronic conditions, self-confidence, body image, time constraints	*"I used to be really fit, but after my diagnosis, even walking feels like climbing a mountain." (P30, 48).* *"Sometimes, I stand outside the gym and then just walk away because I don't feel like I belong." (P72, 39).* *"Most days, it's the choice between rest and movement because there just isn't enough energy after work." (P58, 45).*

Baseline IPAQ and EBBS scores

Baseline scores from the IPAQ and EBBS provided initial insights into participants' physical activity levels and their perceptions of barriers and benefits. The mean total reported PA was 1,250 min per week (SD = 342), and 58% of participants reported meeting or exceeding the recommended 150 min of weekly PA. While the IPAQ typically reports MET-minutes/week to reflect intensity, we have expressed activity in minutes/week for clarity and accessibility.

The EBBS scores revealed a mean benefit score of 3.8 (SD = 0.4) and a mean barrier score of 2.6 (SD = 0.5), indicating that participants generally perceived moderate benefits and barriers to engaging in PA. When disaggregated, participants who met the 150-minute threshold ($n = 65$; 58%) reported significantly lower EBBS barrier scores (mean = 2.4) compared to those who did not (mean = 2.9; $p < 0.05$). This suggests an inverse relationship between perceived barriers and PA engagement.

These baseline findings are situated primarily within the microsystem level of Bronfenbrenner's model, where individual-level factors such as health status, psychological confidence, and perceived value of PA play a central role. These results provide a foundation for understanding how deeper psychological and contextual variables influence women's engagement with physical activity across the ecological spectrum.

Microsystem: health, motivation, and psychological influences

The microsystem encompasses the most immediate and personal influences on PA behaviour. These include individual health status, psychological barriers, self confidence, and time availability. Women in this study reported a range of individual-level challenges that directly shaped their engagement with PA, particularly in relation to chronic health conditions, low self-efficacy, and caregiving responsibilities.

Findings from logistic regression and descriptive analyses highlighted these personal barriers as statistically significant. These trends were further enriched by qualitative narratives, providing a deeper understanding of women's lived experiences. Table 2 presents an overview of key themes and subthemes at the microsystem level, supported by illustrative quotes reflecting psychological, motivational, and health-related factors influencing PA engagement.

Subtheme 1: health status and chronic conditions

Regression analysis (see Table 3) indicated that participants with chronic health conditions were significantly less likely to meet recommended PA guidelines. Specifically, they were 50% less likely to engage in ≥ 150 min of weekly PA (B = -0.692, $p = 0.012$, OR = 0.50, 95% CI:

Table 3 Logistic regression model predicting weekly PA engagement (Model 1a)

Variable	B	*p* Value	Odds Ratio	95% CI
Family/caregiver responsibilities	-0.567	0.045	0.56	0.32–0.99
Low self-confidence	-0.704	0.022	0.49	0.27–0.89
Existing health conditions	-0.692	0.012	0.50	0.29–0.84
Cost of gym memberships/ classes	-0.523	0.034	0.59	0.36–0.97
Constant	–	–	–	–

Note: $R^2 = 0.31$. All models adjusted for age and self-reported health status

0.29–0.84). This inverse relationship between health conditions and PA engagement was echoed in qualitative accounts.

Several participants described physical limitations and pain as demotivating, despite being aware of the benefits of exercise:

> *After my diagnosis, everything changed…exercise feels risky now, not helpful… (P39, 58 years old).*

Such narratives highlight a perception of exercise as potentially harmful, particularly in the absence of personalised or supportive guidance from healthcare professionals. For others, persistent pain or fatigue hindered regular activity.

> *…I want to be more active, but my knees hurt too much after just a short walk […] it makes me feel like it's not worth the effort (P62, 53 years old).*

These findings suggest that generic PA recommendations may not sufficiently address the specific needs of women managing chronic conditions. More adaptive, inclusive strategies are required to overcome these individual-level barriers.

Subtheme 2: Self-confidence and body image

Low self-confidence also emerged as a significant barrier to PA engagement. As shown in Table 3 (Model 1a), regression analysis revealed that participants reporting low self-confidence were less likely to meet PA guidelines (B = -0.704, $p = 0.022$, OR = 0.49, 95% CI: 0.27–0.89). This was reinforced by qualitative data, with many participants describing discomfort in public settings or gym environments.

> *I always feel like people are judging me when I exercise in public, especially because of my size… (P67, 42 years old).*

These feelings of scrutiny and shame were particularly pronounced among participants who had previously attempted structured PA but did not see visible results.

> *…I kept going for three months and didn't lose a pound. It made me question if it's worth the effort… (P50, 47 years old).*

Although quantitative data indicated a high perceived benefit of PA (mean EBBS benefit score = 3.8), these accounts illustrate how body image concerns, low self-efficacy, and perceived lack of progress can diminish motivation. For many, emotional discouragement outweighed the rational understanding of health benefits, especially when compounded by other demands.

Subtheme 3: time constraints and competing responsibilities

Time related barriers were another consistent finding. 45% of participants cited caregiving responsibilities as a significant constraint, and regression analysis (see Table 3) confirmed this association (B = -0.567, $p = 0.045$, OR = 0.56, 95% CI: 0.32–0.99). Notably, although 39% of women identified as single, many reported providing care for elderly parents or extended family, underscoring the complexity of caregiving beyond nuclear family structures.

Participants described how daily routines including work, school runs, and household duties left little time for exercise:

> *…Between school runs, cooking, and looking after my dad, I can't see where exercise fits in… (P56, 52 years old).*

In many cases, traditional gender norms and social expectations intensified this burden. Women frequently described experiencing guilt when prioritising their own health over caregiving duties

> *I tried going to an exercise class after work, but my sister said I was being selfish for leaving the kids […] that stayed with me (P33, 35 years old).*

These insights highlight how structural inequalities and ingrained social roles intersect at the microsystem level, limiting opportunities for PA. Figure 1 visualises the most frequently reported microsystem level barriers among participants, offering a clear summary of these compounding challenges.

While 39% of the sample reported being single, 45% identified family responsibilities as a barrier, suggesting that caregiving in these communities often extends beyond traditional definitions of partnership or parenting. These findings further illustrate how entrenched cultural norms around familial duty and female self sacrifice shape time availability and decision-making around health behaviours.

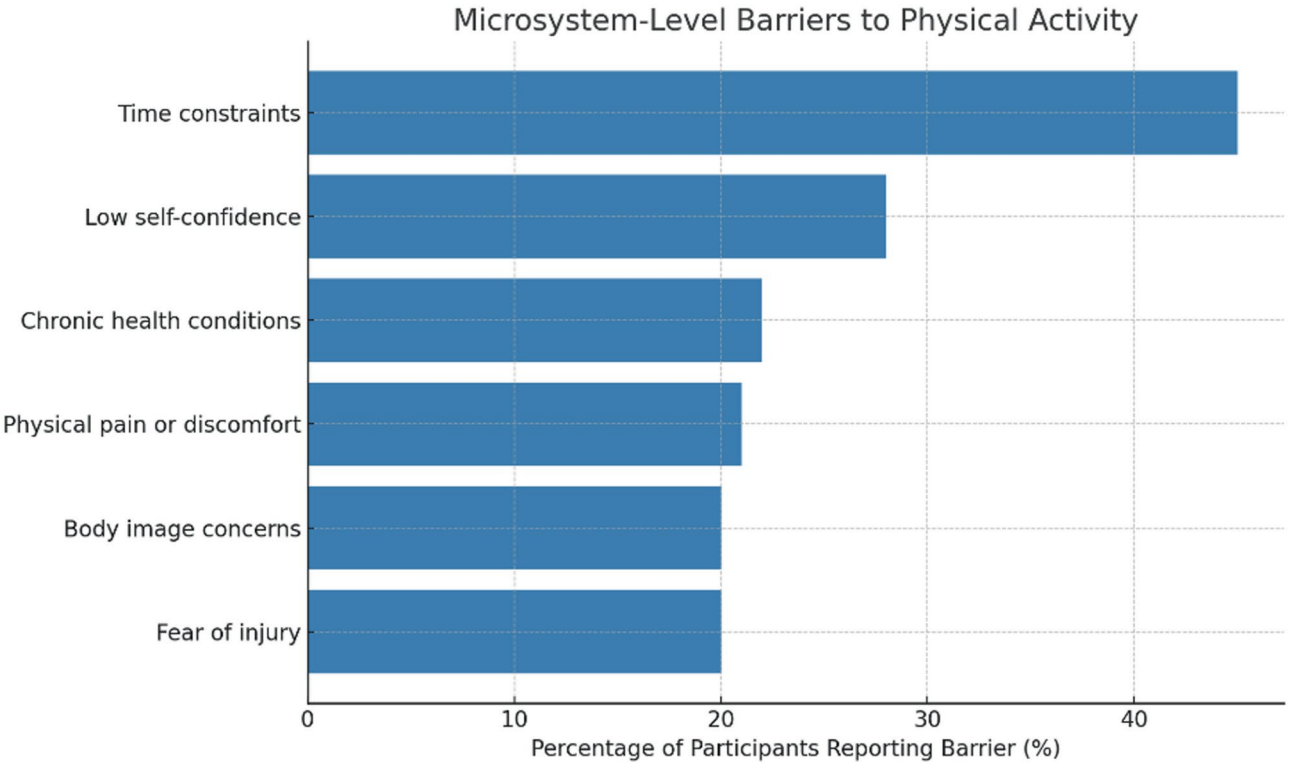

Fig. 1 Microsystem level barriers to PA

Table 4 Mesosystem level themes, subthemes, and illustrative quotes

Interpersonal and institutional relationships	Healthcare interactions, social/peer support, family encouragement or criticism	*"My GP said to exercise, but they didn't ask if I even had the time or money for it." (P24, 38).* *"If my neighbour hadn't pushed me to join her, I would never have started walking sessions." (P89, 50).* *"There's a sense that if you're not already fit, you don't really fit in the group." (P41, 42).*

Mesosystem: interpersonal networks and institutional touchpoints

The mesosystem level encompasses interactions with family members, healthcare professionals, community groups, and peer networks that shape PA behaviour. These interpersonal and institutional connections acted as both facilitators and barriers to engagement, depending on the nature and quality of the support received.

Findings from regression analysis and descriptive statistics provided key insights into information seeking behaviours and support systems, while qualitative narratives enriched this understanding with nuanced accounts of motivation, discouragement, and social comparison. Table 4 summarises the major themes at the mesosystem level, illustrating how social and institutional relationships shaped women's capacity and willingness to engage in PA.

Subtheme 1: healthcare interactions

Healthcare professionals were the most common source of PA information (40%). However, participants' perceptions of these interactions varied widely, with some viewing clinical advice as motivational and others describing it as disconnected from their lived experiences.

> *They tell you to move more, but when? Between work, cooking, and caring for my mum, there's barely time to sit down (P56, 28 years old).*

This quote reflects a dissonance between standardised public health messaging and the complex realities faced by underserved women. While the intention behind such advice is positive, participants felt that it often lacked empathy, personalisation, or practical feasibility particularly for those with competing responsibilities or limited resources.

These findings reinforce the importance of tailoring healthcare communication to the socio-economic and cultural contexts of patients, particularly in port town communities where daily life is shaped by multiple constraints.

Subtheme 2: social and peer support

Social influence was an important enabler. Participants who engaged in PA with friends or within supportive

peer groups described these experiences as more enjoyable and sustainable.

> *Working out with friends makes it more fun and less of a chore…it becomes social as well as physical (P100, 28 years old).*

However, peer environments also introduced feelings of inadequacy or discouragement when participants perceived themselves as lagging behind others.

> *Everyone else seemed to be progressing faster than me […] it made me feel left behind (P69, 40 years old).*

These mixed experiences highlight the dual nature of social support in women's PA participation. While peer interactions can foster motivation through encouragement and camaraderie, they can also diminish confidence when shaped by negative comparisons or perceived judgement. This nuance aligns with the findings from Model 1b (Table 5), which examined predictors of PA related information-seeking behaviour.

Specifically, Black African ethnicity (B = 0.472, $p = 0.030$) and prior participation in a PA programme (B = 0.793, $p = 0.001$) were both positively associated with the likelihood of seeking information related to PA. In contrast, participants with low PA levels were significantly less likely to engage in such information-seeking behaviours (B = -0.839, $p = 0.008$).

Although South Asian, White British, and Other ethnic groups were included in the model as reference categories, only Black African ethnicity emerged as a significant predictor, suggesting that culturally connected peer networks within this group may play a particularly strong role in shaping proactive health behaviours. This insight underscores the potential value of building on existing social capital within these communities to drive engagement.

Table 5 Logistic regression model predicting information seeking behaviour related to PA (Model 1b)

Variable	B	*p* Value	Odds Ratio	95% CI
Low PA level	-0.839	0.008	0.43	0.23–0.82
Participation in a PA programme	0.793	0.001	2.21	1.45–3.38
Black African	0.472	0.030	1.60	1.05–2.42
South Asian	0.211	0.276	1.23	0.85–1.78
White British	Ref	–	–	–
Others	0.108	0.642	1.11	0.71–1.75
Constant	0.728	0.035	2.08	–

Note: $R^2 = 0.29$. Model adjusted for age and self-reported health status

These findings have practical implications for programme design. Community led interventions should prioritise culturally relevant peer support networks that validate diverse experiences and celebrate individual progress. At the same time, practitioners should be aware of the potential risks of normative comparisons, which can discourage participation, particularly among individuals who perceive themselves as 'falling behind'.

Exosystem: infrastructure, accessibility, and community conditions

The exosystem comprises structural and environmental conditions such as transport access, PA facility availability, financial costs, and community safety that either enable or restrict opportunities for PA. Although participants have limited direct control over these conditions, they significantly shape behaviour by influencing what is feasible or accessible in daily life.

In this study, the exosystem emerged as a major barrier to PA participation, with recurring themes around unaffordable facilities, inadequate infrastructure, and geographic isolation particularly characteristic of coastal port communities.

Subtheme 1: physical access, cost, and environmental safety

Quantitative data showed that 27% of participants reported limited access to PA facilities, while 35% identified difficulties with public transport. Financial limitations particularly the cost of gym memberships or classes also emerged as statistically significant predictors of inactivity ($B = -0.523$, $p = 0.034$). These quantitative patterns were reflected and expanded upon in participants' narratives, which described a challenging landscape of logistical, spatial, and economic constraints.

> *There's only one gym near me and it's too expensive. The buses aren't reliable either. If I miss one, I can't make the class (P80, 42 years old).*

> *I live out by the docks […] nothing happens around here, and the roads are dark. It's not safe to walk at night, so I just don't bother anymore (P48, 41 years old).*

These accounts reveal the compounding effects of geography, cost, and unreliable transport particularly for women without private vehicles. The absence of safe, well lit routes further discouraged engagement in simple, low cost activities such as walking or jogging. Safety concerns were especially pronounced among older women and those living alone, who described feelings of vulnerability that further reduced their autonomy to engage in PA independently.

In addition, financial inaccessibility emerged as a persistent constraint. For many, structured physical activity was not a realistic option due to economic precarity.

> *…money is tight. When it's a choice between food, heating, and a gym pass, you already know what I'll pick (P22, 46 years old).*

This narrative reflects how health promoting behaviours like PA are often subordinated to immediate household needs. Even subsidised or council-run programmes were viewed as limited in reach or not culturally appropriate, particularly by women from Black African or South Asian backgrounds. Some expressed frustration at the lack of inclusive options that accounted for cultural norms or transport needs.

Subtheme 2: scheduling, facility design, and weather conditions

Another key theme was the rigidity of PA programme schedules, which disproportionately affected women with shift work or caregiving duties. While interest in participation was high, the limited availability of sessions outside standard work hours posed a major barrier

> *It would be great if there were more evening classes for those of us who work late shifts. Most things happen during the day, when I'm either working or looking after someone (P34, 46 years old).*

Although 34% of participants reported work commitments as a barrier in the survey, the qualitative narratives illuminated how timing, employment type, and household responsibilities intersected, making many existing PA options inaccessible.

Weather conditions further complicated access. Participants described how poor weather, especially during winter months in coastal areas like Great Yarmouth and Lowestoft, discouraged outdoor activity.

> *…it's hard to stay motivated when it's raining all the time, and there aren't many indoor options nearby. We need proper spaces to use all year round (P91, 34 years old).*

This highlights how environmental and temporal factors constrain opportunities for consistent PA, especially in areas lacking adequate indoor infrastructure. Participants consistently voiced a need for sheltered, affordable, and locally situated facilities that would allow them to stay active throughout the year, regardless of weather or work schedule.

These findings emphasise how 'locational disadvantage', a structural constraint rooted in where people live can significantly undermine even high levels of individual motivation or intention. Women in these communities are not merely 'unmotivated' or 'inactive'; rather, they are navigating a daily reality shaped by economic hardship, spatial exclusion, and inadequate services.

This highlights the need for public health strategies to directly address exosystem level barriers through sustained investment in infrastructure, culturally inclusive programming, flexible scheduling, and safe transport networks. Figure 2 visually summarises the distribution of exosystem-related barriers across the sample.

Table 6 provides additional illustrative quotes from participants describing their structural and environmental constraints.

Macrosystem: cultural norms, beliefs, and National health discourses

The macrosystem encompasses broad societal ideologies, cultural norms, and national-level discourses that shape both individual and community level experiences of PA. For the underserved women in this study, intersecting influences related to gender roles, modesty, religion, and public health expectations significantly impacted how PA was perceived, prioritised, and enacted in everyday life.

While these cultural and normative influences were not directly captured in quantitative measures, rich qualitative narratives illuminated their complex and often constraining role, highlighting the importance of integrating culturally sensitive frameworks into public health research and programme design.

Subtheme 1: cultural beliefs and modesty norms

Among participants, particularly those from South Asian and Black African backgrounds, cultural expectations around modesty and appropriate public conduct strongly shaped PA engagement. These expectations were often reinforced through gendered and religious values, influencing what types of activity were deemed acceptable, where they could be performed, and with whom.

> *There aren't many women-only spaces here […] I would feel exposed doing Zumba in front of men, so I just avoid it (P88, 36 years old).*

> *In our culture, women are not meant to be sweating and jumping around in front of others…it feels shameful, even though I know it's for health (P63, 40 years old).*

These narratives may illustrate how both internalised beliefs and community expectations act as significant barriers to participation. Several women expressed a desire for culturally congruent activities, such as

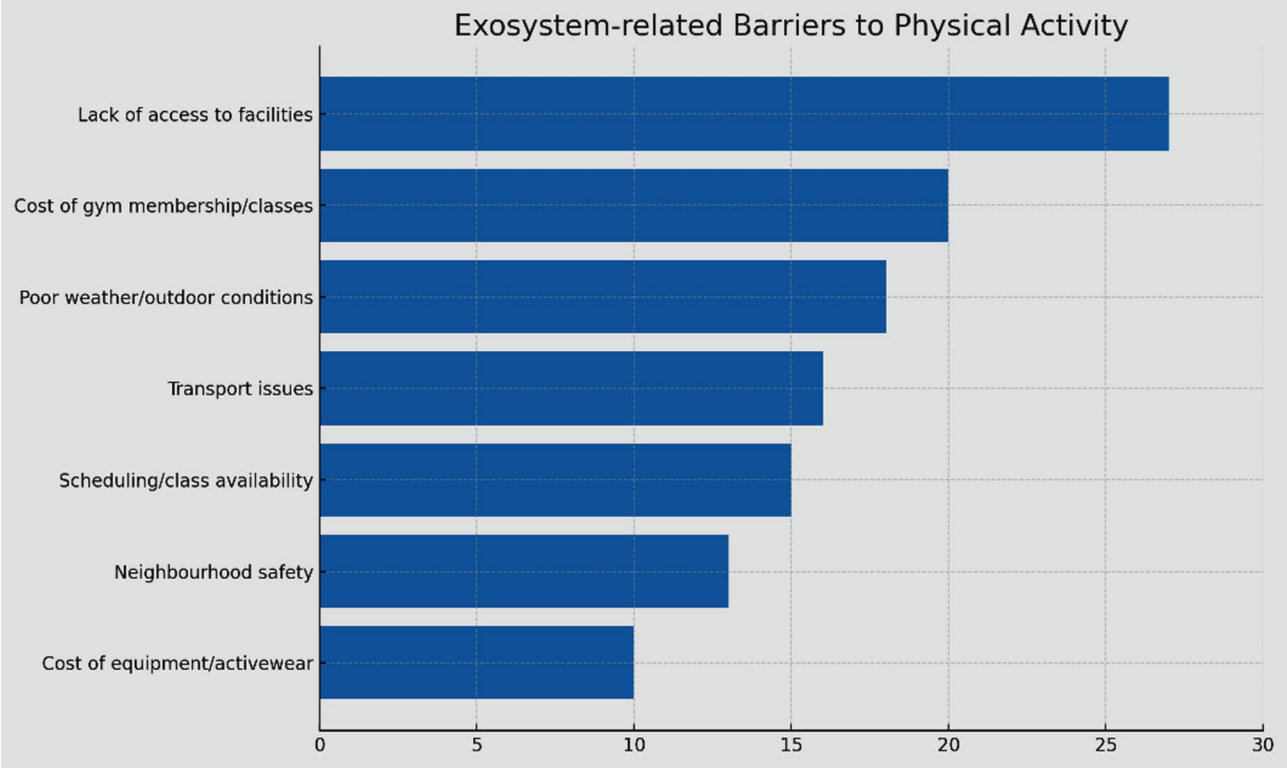

Fig. 2 Distribution of exosystem-related barriers to PA among participants

Table 6 Exosystem level themes, subthemes, and illustrative quotes

Structural and environmental barriers	Access to facilities, cost, transport, scheduling, weather, neighbourhood safety	*"Getting to a gym means two buses and over an hour each way. It's just not realistic." (P12, 36). "It's dark by 4 pm in winter and I don't feel safe walking, so I just stay inside." (P86, 51). "The council runs some classes, but they're full by the time I hear about them." (P77, 40).*

traditional dance classes or women-only fitness sessions to help reduce discomfort and increase uptake:

> *It would be nice if the programmes included dance styles from our culture…it makes it more enjoyable and less awkward (P71, 38 years old).*

These insights point to the need for culturally inclusive and flexible programme design that respects the plurality of identities and lived experiences within underserved communities.

Subtheme 2: gender roles and Familial duty

Many participants described the persistent influence of traditional gender roles, which positioned caregiving and domestic responsibilities above personal health. These roles were often internalised as duty, and when disrupted, such as by attending PA programmes, generated guilt or familial criticism:

> *My husband said it was selfish of me to go to the gym while the kids were home. That made me stop (P29, 37 years old).*

> *Even when I want to take a walk, I feel like I'm neglecting the housework. It's just not encouraged for women to take time for themselves (P77, 45 years old).*

Such perceptions were particularly entrenched in households upholding traditional or patriarchal values. At the macrosystem level, these social scripts limited women's autonomy and reduced their perceived legitimacy to prioritise personal wellbeing. Participants described these roles as intergenerational, deeply embedded, and resistant to individual change without wider community or institutional support.

Subtheme 3: public health messaging and perceived moral judgement

Participants also critiqued national public health messaging, noting that it often failed to resonate with their lived realities. Slogans like *"just 30 minutes a day"* or *"move more"* were seen by some as overly simplistic and disconnected:

> *They make it sound so easy, like just go for a walk. But they don't live where we live or deal with what we deal with (P36, 34 years old).*

Beyond this, many reported a sense of being morally judged or blamed by public health campaigns that failed to account for financial hardship, safety concerns, and cultural constraints:

> *They act like it's your fault you're not active [.] but they don't see that we can't afford a gym or don't feel safe walking after dark (P51, 44 years old).*

These accounts suggest that well-meaning health promotion strategies may unintentionally reinforce stigma or marginalisation if not grounded in a contextual understanding of everyday barriers.

To be effective, public health efforts must move beyond deficit-based or individualising language and instead adopt empowering, locally tailored messages that reflect the social realities of underserved women.

Table 7 presents a consolidated overview of the key macrosystem-level themes, including modesty norms, gendered caregiving roles, and critical responses to national health discourse. These themes highlight the systemic and symbolic forces that shape how women from diverse backgrounds perceive and engage with PA.

Chronosystem: Temporal shifts and life transitions

The chronosystem reflects the dimension of time, capturing life transitions, generational shifts, and socio political changes that shape the broader context in which women engage with PA. While this level was not quantitatively measured, qualitative narratives revealed how evolving circumstances over the life course significantly influenced patterns of PA engagement.

Notably, while findings from logistic regression and descriptive analysis highlighted individual barriers, such as chronic health conditions, low self-confidence, and time constraints, these were often compounded or altered by temporal shifts that emerged as critical themes in the qualitative data. This underscores the complementarity of data sources, particularly in capturing long-term dynamics that cross-sectional survey instruments may miss.

Table 7 Macrosystem level themes, subthemes, and illustrative quotes

Cultural and gender norms, health discourses	Modesty, gender roles, religious beliefs, perceived public health judgment	*"Back home, women don't run around in public spaces; it's considered shameful." (P10, 44).* *"Taking time for myself feels wrong, like I'm letting my family down." (P25, 37).* *"They say just 'move more,' but it's like they have no idea how hard it actually is here." (P61, 34).*

Subtheme 1: life course transitions

Participants described how different life stages, including pregnancy, parenting, menopause, and caregiving reshaped or interrupted their ability to maintain consistent PA habits. These transitions were not only biological but also emotional and social, requiring significant adaptation in routines and motivation.

> *I used to be very active, but after I had my son, it just wasn't possible anymore…I never really got back to it (P15, 30 years old).*

Others shared how hormonal and physical changes associated with menopause made traditional forms of PA more difficult or less appealing:

> *Since hitting menopause, I feel more tired and less confident…everything hurts more, so I don't even try sometimes (P83, 54 years old).*

These reflections highlight the need for flexible and age responsive PA programming that adapts to changes in energy levels, physical capacity, and emotional readiness. They also reveal how women's engagement with PA is situated within a fluid, non-linear trajectory, challenging one-size-fits-all approaches to intervention.

Subtheme 2: Long-term community and systemic change

In addition to personal life changes, participants emphasised how system level instability impacted long-term PA engagement. Many referenced the closure of local services, withdrawal of funding, and inconsistent programme delivery, which collectively eroded momentum and trust.

> *There used to be a great class at the community centre, but it was cancelled when funding was cut. Since then, I haven't done much (P44, 50 years old).*

> *Everything changes so quickly– one day there's a programme, the next it's gone. We need consistency to keep us going (P92, 41 years old).*

Table 8 Chronosystem level themes, subthemes, and illustrative quotes

Life course and community change	Motherhood, menopause, ageing, service cuts, programme instability	*"Before I had my kids, I was really active, but priorities shift and it's hard to get back." (P37, 31).* *"The gym closed down and there's been nothing affordable since then." (P84, 50).* *"As I got older, especially post-menopause, even getting out for a walk became harder." (P49, 56).*

These accounts underscore the importance of policy continuity, long-term investment, and sustainable community infrastructure to support women's ongoing participation. The findings also illustrate how external, macro temporal factors intersect with personal motivation, disrupting behaviour change efforts despite women's initial interest or success. Table 8 outlines the chronosystem-level themes and illustrative quotes, including key life transitions and wider community-level disruptions that influenced women's sustained PA engagement.

To visually consolidate these integrated findings, Fig. 3 presents a visual summary of the proportion of participants who reported barriers to PA across the five ecological levels of Bronfenbrenner's model. This figure integrates both quantitative survey data and coded qualitative themes to capture the multi-level nature of constraints experienced by underserved women in coastal communities. Each barrier was mapped to the primary ecological level at which it was described or discussed by participants, although many women encountered overlapping influences across multiple levels. The figure highlights the layered, cumulative impact of individual, interpersonal, structural, cultural, and temporal dynamics on PA engagement, reinforcing the necessity of multi-level interventions that address not only personal motivation but also social roles, environmental conditions, and policy-level stability.

Divergences between quantitative and qualitative findings

While the integration of quantitative and qualitative data produced broadly convergent insights across the five ecological levels, several critical divergences emerged. These discrepancies enriched our understanding of women's PA engagement by surfacing contextual and emotional dimensions that standardised tools could not fully capture.

As shown in Table 9, a cross-ecological summary of key themes illustrates how quantitative insights often align with, but also diverge from qualitative narratives across different levels of influence. These findings emphasise the value of a mixed methods approach in capturing both

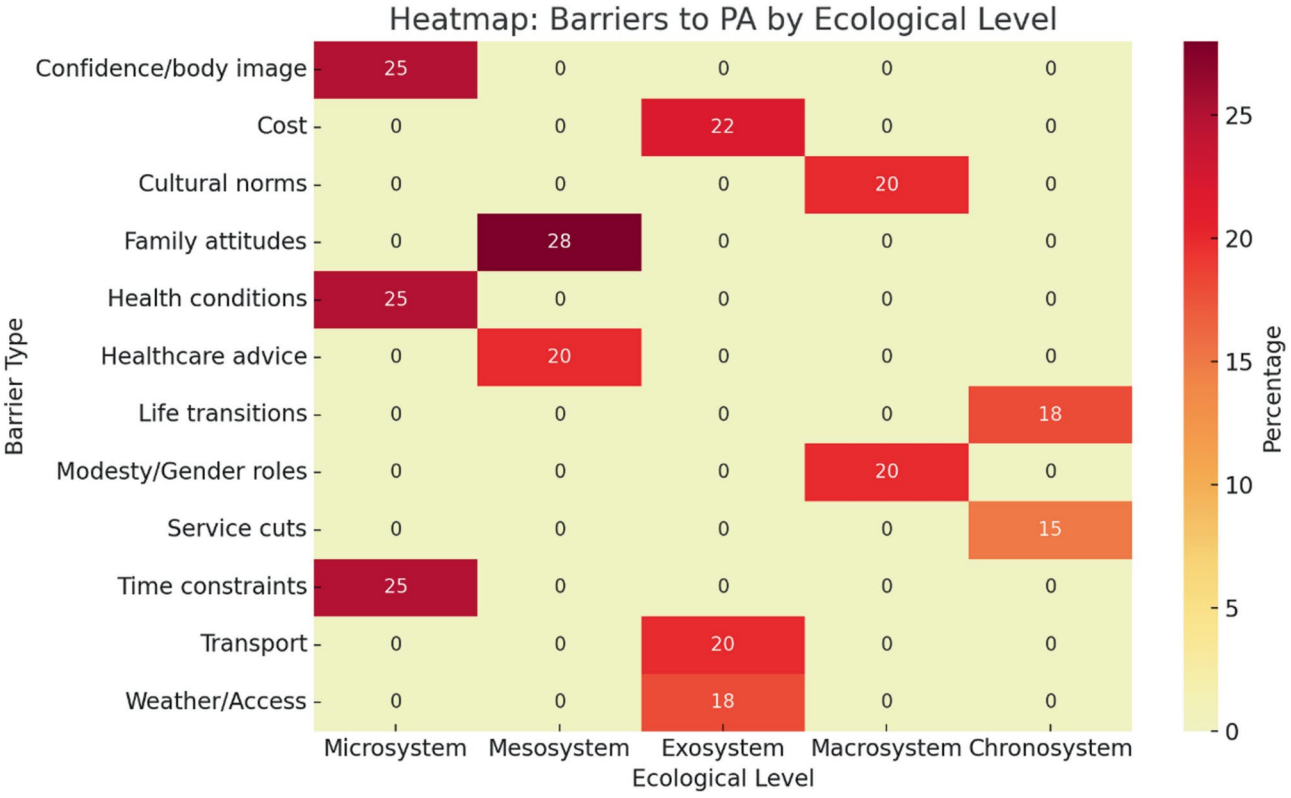

Fig. 3 Distribution of reported barriers to PA by ecological level. *Note* Distribution of key barriers to PA participation (in % of participants), mapped across five ecological levels based on Bronfenbrenner's Ecological Systems Theory. Data reflect integrated findings from survey and qualitative themes ($N = 112$)

Table 9 Cross-ecological summary of key themes and illustrative quotes

Theme	Quantitative insight	Qualitative narrative	Interpretation
Health benefits	High EBBS benefit scores (mean = 3.8)	Scepticism due to lack of visible progress	Need for realistic messaging
Info source	40% cite healthcare	Advice seen as rushed/insensitive	Quality of interaction matters
Caregiving	45% cite as barrier	Embedded guilt & gender norms	Quant data misses emotional depth
Safety/transport	35% cite transport issues	Unsafe roads, poor lighting, fear	Exosystem-level risk perception
Chronosystem	Not measured	Menopause, programme closures	Highlights need for longitudinal tools

measurable patterns and lived experiences within underserved port communities.

Perceived benefits versus experienced outcomes

Quantitative data from the EBBS indicated relatively high perceived benefits of PA among participants (mean score = 3.8). However, qualitative narratives revealed scepticism, frustration, and emotional disillusionment regarding the actual benefits achieved through participation. Several women reported no noticeable changes in weight, mood, or wellbeing despite consistent engagement in PA, with some questioning the worth of continued effort:

> *"I kept going for three months and didn't lose a pound. It made me question if it's worth the effort..." (P50, 47).*

This disconnect highlights how perceived value captured through surveys may not translate into sustained motivation, particularly when expectations are unmet. It highlights the importance of realistic, supportive, and contextually grounded health messaging.

Healthcare interactions: reported source versus lived experience

While 40% of survey respondents identified healthcare professionals as their main source of PA information, interview narratives painted a more ambivalent picture. Participants often described these interactions as rushed, dismissive, or lacking cultural sensitivity. The nuance captured through qualitative data illuminated a disconnect between institutional advice and lived realities:

> *They tell you to move more, but when? Between work, cooking, and caring for my mum, there's barely time to sit down. (P56, 28).*

This divergence signals the need for empathetic, individualised guidance that takes into account the socioeconomic and cultural contexts of marginalised women.

Structural barriers versus emotional and cultural dimensions

Quantitative data captured cost, time, and transport as leading barriers. However, the qualitative data added emotional, relational, and cultural layers to these constraints. For example, caregiving emerged not only as a time burden (45% in surveys) but also as a source of guilt, internal conflict, and cultural expectation:

> *My sister said I was being selfish for leaving the kids... that stayed with me. (P33, 35).*

Likewise, religious practices, modesty norms, and discomfort in mixed-gender environments, particularly among Black African and South Asian participants were absent in survey tools but featured strongly in interviews, shaping reluctance to engage in public or group-based PA.

These findings highlight the limitations of standardised quantitative instruments in capturing emotional, relational, and cultural complexities, particularly those embedded within underserved communities. They reinforce the need for culturally tailored data collection tools that better reflect these lived realities.

Temporal dynamics and life transitions

Qualitative findings also brought attention to temporal and life-course influences such as pregnancy, menopause, and local service disruptions that were not captured in the cross-sectional quantitative tools. Participants highlighted how life transitions and policy instability for example, funding cuts created ongoing disruptions to PA routines:

> *"There used to be a great class at the community centre, but it was cancelled when funding was cut." (P44, 50).*

This divergence reinforces the need for longitudinal approaches and sustained community investment to support women's evolving engagement with PA over time.

To consolidate the ecological influences identified through our integrated analysis, Fig. 6 presents a visual conceptual framework depicting the layered barriers to PA engagement among underserved women in port communities, organised according to Bronfenbrenner's Ecological Systems Theory.

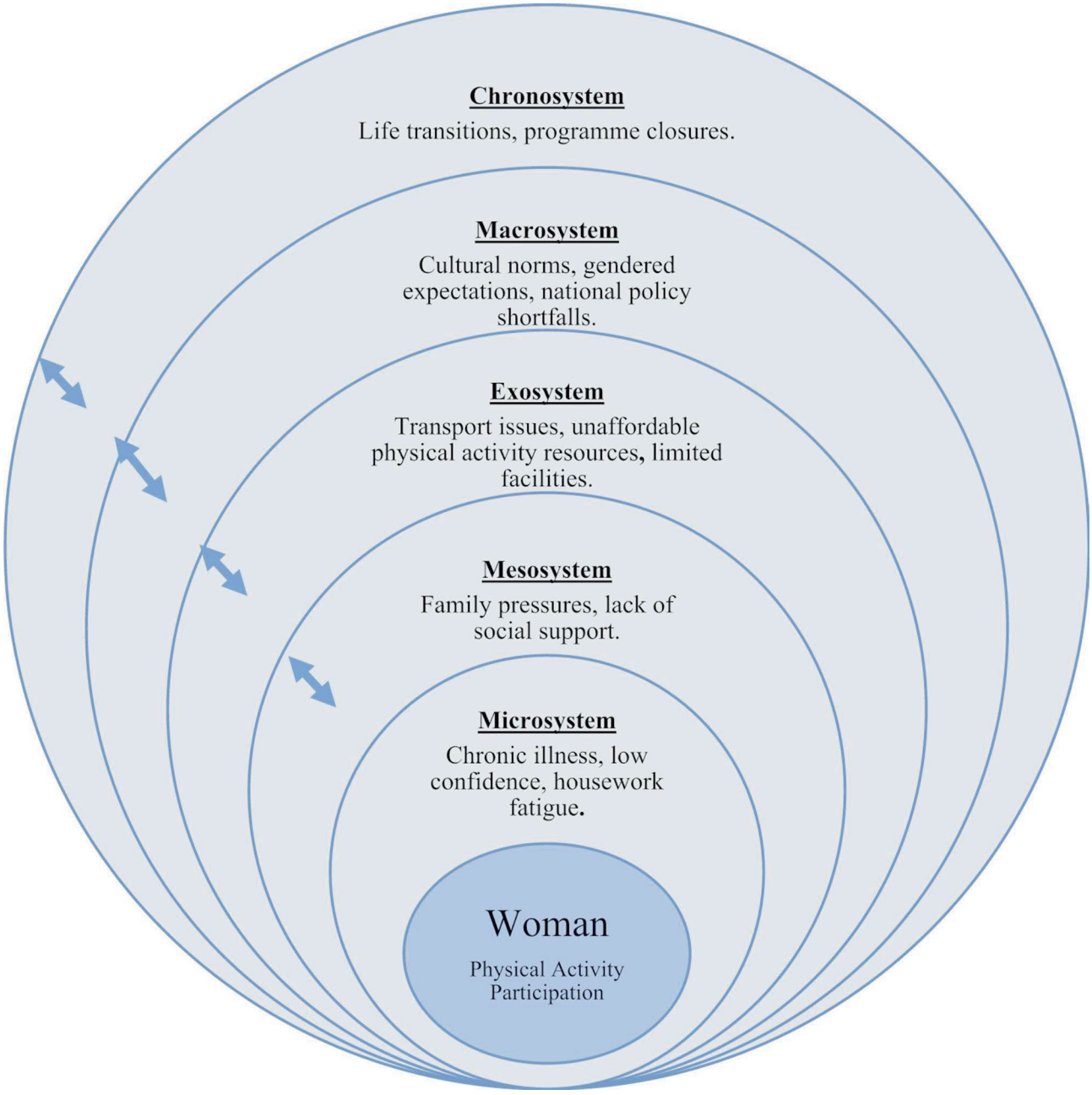

Fig. 4 Ecological Conceptual Model of PA Barriers Among Underserved Women

Rather than duplicating the detailed themes already described in the results tables, the model offers a simplified, overarching view of the ecological levels and key dynamics influencing behaviour. It highlights how immediate individual factors, interpersonal and social pressures, structural and environmental conditions, cultural norms, and broader life course changes interact to shape PA engagement. This conceptualisation underscores the cumulative and intersecting nature of barriers and enablers, reinforcing the need for integrated, multi-level, and equity-focused interventions tailored to the realities of structurally underserved populations.

Discussion

This study contributes novel insights into the complex and multi-layered determinants of PA engagement among underserved women. Guided by Bronfenbrenner's Ecological Systems Theory [30], the findings demonstrate that women's engagement in PA is shaped not by singular behavioural choices but through intersecting and cumulative influences across ecological levels:

microsystem, mesosystem, exosystem, macrosystem, and chronosystem.

Microsystem: health, confidence and competing demands

At the individual level, health status, psychological confidence, and caregiving responsibilities emerged as significant determinants of PA behaviour. Quantitative results showed that women with chronic conditions were 50% less likely to meet weekly PA guidelines, while those reporting low self-confidence were also significantly less likely to participate in regular PA. These findings corroborate existing evidence that chronic illness can serve as both a physiological and psychological barrier to exercise, particularly when healthcare systems fail to provide adaptive, condition-sensitive PA advice [13, 61, 62].

Qualitative narratives expanded these findings by illustrating how poor health was often associated with fear of injury, diminished confidence, and a perception that exercise was risky or even counterproductive. This aligns with recent literature demonstrating that perceived physical vulnerability can undermine exercise self-efficacy, especially among middle-aged and older women [63–65]. Furthermore, body image concerns, embarrassment, and previous failed attempts at weight loss were reported as demotivating factors, echoing research by Wills et al. [66] and Wheatley et al. [67], who found that social comparison and perceived judgement often impede PA uptake among women.

Caregiving responsibilities further constrained women's capacity to prioritise their health. Despite nearly 40% of participants identifying as single, over 45% reported caregiving as a barrier, suggesting a broader, culturally embedded sense of familial duty beyond nuclear parenting. These findings echo wider evidence on time poverty among women and the disproportionate burden of unpaid domestic labour [68–70], further reinforcing the gendered nature of PA disparities. These converging findings illustrate how quantitative measures can identify patterns of health limitations and caregiving burden, while qualitative data add emotional nuance, highlighting internalised guilt, bodily discomfort, and fractured self-confidence that impede behavioural change.

Mesosystem: interpersonal and institutional interactions

Interpersonal relationships with family, peers, and healthcare providers played a dual role in either enabling or obstructing PA engagement. Regression analysis indicated that participants identifying as Black African were significantly more likely to engage in PA-related information-seeking, underscoring the value of culturally rooted peer networks in supporting behaviour change. This supports previous findings by Grace et al. [10] and Babakus and Thompson [9].

However, healthcare professionals were often described as providing generic or unrealistic advice. Although 40% of participants cited clinicians as sources of information, qualitative data revealed a lack of cultural sensitivity and contextual relevance in these interactions. This is consistent with prior critiques of biomedical advice being decoupled from real-world lived experiences [71–73]. For underserved women balancing multiple roles, standardised messages to move more were perceived as reductive and disempowering.

Peer influence was another salient factor within the mesosystem. Exercising with friends enhanced motivation and social enjoyment, aligning with the findings of Eyler et al. [74] and Lindsay Smith et al. [75], who argue for the relational nature of PA. Yet peer comparison also generated feelings of inadequacy, especially among women who felt they progressed more slowly than others. This tension underlines the importance of creating inclusive, non-competitive environments in PA programmes, particularly for women with low baseline fitness or chronic health conditions. Together, these findings show how meso-level interactions either amplify or erode women's confidence and motivation, depending on the quality of engagement. Importantly, they reveal divergences between reported information sources and perceived usefulness, highlighting the need for more empathetic and context-aware institutional guidance.

Exosystem: infrastructure, safety, and economic constraints

Structural factors within the exosystem level were reported as critical barriers to PA, particularly in the context of post-industrial coastal towns where public services have declined over decades. Limited availability of affordable and culturally appropriate facilities, unreliable public transport, and unsafe neighbourhoods were recurring themes. These findings resonate strongly with the literature on locational disadvantage [14, 16, 76], where the spatial and infrastructural environment acts as a systemic constraint on health promoting behaviours.

Cost was a statistically significant predictor of inactivity in this study, a finding consistent with Sport England [6] and earlier research by Panter et al. [77]. However, qualitative accounts brought greater emotional nuance, illustrating that financial trade-offs between PA and essential needs (for example food or heating) rendered exercise a luxury. This supports the concept of structural vulnerability in public health, where socioeconomic precarity reduces the ability to engage with even low-cost services [22, 78].

Safety concerns, particularly in poorly lit areas or during early mornings and evenings, were also noted as deterrents. This aligns with findings from Hanson and Jones [19] and Foster and Giles-Corti [79], who highlight

the importance of perceived safety in women's PA decisions. These findings affirm that PA is not merely an individual health behaviour, but an act deeply embedded in the material, economic, and geographic conditions of daily life. These convergences between quantitative predictors and qualitative lived experience reinforce the centrality of environmental injustice in shaping health inequalities. PA is not a freely chosen behaviour, but an outcome deeply rooted in geographic, economic, and infrastructural realities.

Macrosystem: cultural norms and public health messaging

The broader cultural and ideological context, or macrosystem, exerted a powerful influence over women's perceptions and practices around PA. In particular, cultural expectations around modesty and gender roles, especially among South Asian and Black African participants, shaped how, where, and whether women felt comfortable engaging in PA. These findings reinforce those of Ominyi, Clifton and Cushen-Brewster [85], who describe how socio-religious values can either constrain or enable participation depending on the inclusivity of local programmes.

Many participants reported a lack of women-only spaces and discomfort with mixed-gender environments, highlighting a mismatch between public provision and cultural acceptability. The call for culturally relevant PA interventions echoes Mannell et al. [34] and Douglas et al. [80], who argue that inclusivity requires more than translation of materials; it necessitates deep alignment with community values and priorities.

Additionally, public health campaigns were critiqued for relying on deficit-based messaging that assumed behavioural autonomy while ignoring structural constraints. Phrases such as *just 30 min a day* were perceived as oversimplifying the realities of working-class or caregiving women in deprived areas. This finding aligns with Crawford [21], and recent studies by Parnell et al. [25], Haregu et al. [22] and Ominyi and Clifton [86], who caution that individualised framing in health promotion can lead to shame and disengagement among marginalised groups. These insights underline how macrosystem-level messages, when decontextualised, may inadvertently exacerbate exclusion, particularly among women for whom PA is entangled with norms around visibility, respectability, and family obligations.

Chronosystem: life course transitions and policy instability

Temporal factors within the chronosystem, such as motherhood, menopause, ageing, and community-level change, emerged as critical but often neglected determinants of PA engagement. Participants described how pregnancy and parenting disrupted exercise routines, sometimes permanently. This finding aligns with Brown et al. [81] and more recently, Clark and Wiltshire [82], who found that motherhood is a key transition point leading to long-term reductions in PA.

Similarly, menopause was associated with reduced energy and confidence, highlighting the importance of life-course responsive interventions. These experiences echo findings by Elavsky et al. [83] and Im et al. [84], who suggest that hormonal and psychosocial changes in midlife women necessitate tailored exercise support.

Participants also reflected on community-level disruptions, such as service closures or funding cuts, which dismantled previously effective programmes. These instabilities not only broke behavioural routines but also eroded trust and continuity, key ingredients for sustained engagement. As noted by Densley et al. [26] and Parnell et al. [25], policy inconsistency undermines long-term public health goals, especially in underserved communities where alternatives are limited. The chronosystem findings reinforce the limitations of cross-sectional designs in capturing long-term behavioural shifts. They highlight the need for longitudinal research and policy continuity to ensure that PA engagement is both supported and sustained across life transitions.

Strengths and limitations

This study offers several key strengths that enhance its rigour, contextual relevance, and contribution to public health knowledge. First, it is one of the few UK based studies to explore PA participation among underserved women in post-industrial port communities using a mixed methods convergent design guided by Bronfenbrenner's Ecological Systems Theory [30]. This allowed for nuanced, multi-level mapping of barriers and enablers across microsystem to chronosystem levels, illuminating influences that are typically underexplored in national surveys or behavioural interventions.

Second, the study adopted a theory driven yet flexible data integration strategy that enabled in-depth exploration of intersecting factors such as ethnicity, caregiving roles, infrastructure, cultural norms, and temporal life transitions. By engaging 112 participants with a high representation of Black African and South Asian women, it foregrounded the voices of groups often marginalised in UK public health research. Purposeful outreach and trusted community partnerships contributed to the successful recruitment of participants who are frequently underrepresented.

Third, the study employed validated quantitative instruments (IPAQ-SF and EBBS) alongside embedded qualitative prompts that captured real-world narratives, ensuring a balance between generalisability and contextual specificity. Data saturation and inter-coder reliability were also achieved through rigorous qualitative coding practices. Mixed-methods integration enabled

the triangulation of lived experiences with measurable trends, while thematic coding reliability and saturation enhanced analytic rigour.

However, a few limitations must be acknowledged. The cross-sectional design limits causal interpretations, particularly concerning life course transitions and policy-related influences over time. While the chronosystem was robustly explored through narrative accounts, its lack of direct measurement in the survey limits the triangulation of time-based variables.

Additionally, the majority of participants were women who were already attending PA or weight-loss programmes. While this provided valuable insights from those actively navigating participation, the findings may not be generalisable to all women across Suffolk and Norfolk's port communities, particularly those disengaged from such services. Nonetheless, these insights may still reflect the grounded realities of underserved populations and highlight the systemic barriers encountered even by relatively motivated individuals.

Moreover, although the inclusion of women from ethnic minority backgrounds enhances the study's relevance, the exclusive use of English-language surveys may have excluded non-English speakers, potentially overlooking the perspectives of recently arrived migrant populations. Similarly, the educational attainment of participants was higher than that of the general underserved population in the study areas, with over 75% holding a bachelor's or postgraduate degree. This may have influenced participants' health literacy, information-seeking behaviours, and engagement with physical activity opportunities, and thus limits the broader generalisability of the findings.

Lastly, while the study captured experiences across a wide age range (18–65), further research is needed to explore physical activity engagement among older women aged 65+, or adolescents under 18, whose motivations, enablers, and barriers may differ substantially. Despite these limitations, the study offers robust, contextually grounded insights that are essential for informing culturally responsive, multi-level PA interventions in underserved communities.

Implications and recommendations

Findings from this study offer important implications for policy, practice, and future research aimed at improving PA participation among underserved women in coastal port communities.

There is a clear need for targeted investment in physical infrastructure that supports year-round, accessible PA options. Local authorities and Integrated Care Systems (ICS) should prioritise funding for safe, affordable, and culturally appropriate facilities, including women-only sessions and sheltered spaces. Transport planning should also consider the mobility constraints of women reliant on public transport, particularly in low-income coastal areas.

Behavioural change strategies must move beyond individualised messaging and instead be co-designed with community members to reflect the intersecting barriers these women face. Physical Activity initiatives must move beyond generic behavioural messaging and instead co-design interventions that reflect the lived experiences of underserved women. Programmes should incorporate flexible scheduling, childcare provision, and culturally inclusive activities such as traditional dance or modesty-friendly exercise classes. Community-based peer support models may be particularly effective in building confidence and sustaining motivation.

Primary care practitioners should be supported to deliver personalised, culturally sensitive PA advice. Training in motivational interviewing and cultural competence could improve the quality of interactions, particularly among patients with chronic health conditions or caregiving responsibilities.

Future studies should adopt longitudinal designs to capture the impact of life-course transitions and community-level change on PA engagement over time. Mixed methods approaches should continue to be used to deepen understanding of divergent experiences within underserved populations. Mixed-methods and ecological approaches should continue to be used to explore the interplay between individual, social, and structural determinants. Developing and validating culturally tailored measurement tools may also enhance the reliability of future studies in diverse contexts.

Finally, public health teams should strengthen collaborations with grassroots organisations already embedded within ethnic minority and coastal communities. These groups are uniquely positioned to identify local needs and build trust, especially in areas where institutional engagement has historically been low. Funding models that recognise and sustain the work of such organisations will be essential for long-term impact.

Conclusion

This study contributes novel, evidence-based insights into the complex and layered influences that shape PA participation among underserved women post-industrial port communities. While national statistics often overlook the compounded disadvantages faced by women in these regions, this research highlights the importance of designing context specific, equity oriented interventions that address barriers across ecological levels. Findings challenge the effectiveness of one-size-fits-all messaging and underscore the need for systemic changes in how PA is promoted, facilitated, and sustained in structurally marginalised communities. Addressing physical inactivity among underserved women will require coordinated

action across healthcare, local government, and community sectors. By amplifying the voices of women often left out of policy discourse, this study helps pave the way for inclusive, multi-level strategies that move beyond individual responsibility and toward structural equity in health promotion.

Abbreviations

PA	Physical Activity
EBBS	Exercise Benefits and Barriers Scale
IPAQ-SF	International Physical Activity Questionnaire– Short Form
SPSS	Statistical Package for the Social Sciences
NHS	National Health Service
CMO	Chief Medical Officer
NCDs	Non-Communicable Diseases
TAAF	Together an Active Future
ICS	Integrated Care Systems
GDPR	General Data Protection Regulation
OR	Odds Ratio

Supplementary Information

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Supplementary Material 1

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Author contributions
JO and AN led the conceptualisation and methodology development of this study. JO and AC conducted the investigation, validated the results, and performed data curation and formal analysis. JO also drafted the manuscript and supervised the study, providing the necessary resources to support its completion. AN contributed to the study by assisting with analysis, proofreading, and editing. All authors reviewed and approved the final version of the manuscript.

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Data availability
The data presented in this study are available on request from the corresponding author. The data are not publicly available due to ethical restrictions.

Declarations

Ethics approval and consent to participate
The study was conducted in accordance with the guidelines of the Declaration of Helsinki and was approved by the University of Suffolk's Research Ethical Approval System (reference ID: RETH24/018). Ethical approval from the Health Research Authority (HRA) was waived, as the study did not involve patients, minors, or clinical trials or pose any risks to participants, in alignment with UK national regulations. Informed consent was obtained from all subjects involved in the study.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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