Psychophysiology

WILEY | SPR Society for Psychophysiological Research

ORIGINAL ARTICLE OPEN ACCESS

Multiple Group Membership and Cardiovascular Reactivity in Women: Moderation by the Number of Groups Perceived as Targets of Discrimination

Lisa Skilton[1] | Aoife-Marie Foran[1,2] | Grace McMahon[1] | Orla T. Muldoon[1,3]

[1]Department of Psychology, Centre of Social Issues Research, University of Limerick, Limerick, Ireland | [2]The University of Queensland, Brisbane, Australia | [3]Queens University Belfast, Belfast, UK

Correspondence: Lisa Skilton (lisa.skilton@ul.ie) | Orla T. Muldoon (o.muldoon@qub.ac.uk)

Received: 14 August 2025 | **Revised:** 10 April 2026 | **Accepted:** 20 April 2026

Keywords: cardiovascular reactivity | discrimination | gender identity | social identity | stress | women

ABSTRACT

This study examined whether multiple group membership (MGM) predicted future cardiovascular reactivity (CVR) in women and whether this relationship was moderated by the number of social group memberships they perceived to be the basis for their discrimination. Using a longitudinal design, data were drawn from Waves 2 and 3 of the Midlife in the United States (MIDUS) study. The sample included 179 women for diastolic and systolic blood pressure (DBP, SBP) reactivity and 200 women for heart rate (HR) reactivity (ages 47–94, $M = 63.66$, $SD = 8.90$). Greater MGM at Time 1 was associated with lower HR responses to stress at Time 2, indicating reduced cardiovascular responding during the stress tasks. Moderation analyses revealed that among women who attributed discrimination to one group, higher MGM predicted higher HR reactivity suggesting a more engaged stress response. In contrast, among women who did not attribute discrimination to any group, higher MGM was significantly associated with lower HR reactivity. No significant effects were found for SBP and DBP reactivity. Together, these findings suggest that MGM does not uniformly confer stress-buffering benefits and may, in some contexts, reflect cumulative social burden rather than protection. The results highlight the importance of considering the social meaning and context of group memberships, particularly experiences of discrimination, when evaluating their implications for women's stress-related health.

The social cure hypothesis (Jetten et al. 2009) highlights the significant health benefits of group membership (GM). According to this perspective, these benefits arise when individuals incorporate group memberships into their sense of self, forming a social identity that becomes a valuable psychological and social resource (see Jetten et al. 2014). The foundational social identity theory (Tajfel and Turner 1979) found that *mere* group memberships, even in the absence of meaningful interaction, can influence individuals' sense of self and behavior. As a rule of thumb, if you choose to join even one group after being a member of none, your chance of dying within the next year is cut in half (Putnam 2000).

A large body of research demonstrates that individuals who belong to a greater number of social groups tend to report better psychological well-being, improved physical health, and greater longevity compared to those with fewer group memberships (e.g., Berkman 1995; Holt-Lunstad et al. 2010; Jetten et al. 2015). This work shows that there are potential benefits to *mere belonging to important groups*. That is, even though not all group memberships function as psychological resources for their members, many do. This is because group memberships are a basis for defining the self that individuals can effectively utilize the psychological resources they provide. In the present paper, we use data available via MIDUS on community

group participation in religious meetings, unions/professional groups, sports/social groups, and other groups as a marker of group memberships. Multiple group membership (MGM) refers to the number of these group memberships each person reports, as prior work suggests the effects of memberships may be cumulative.

Across the literature, MGM has been operationalized using both subjective indicators (e.g., perceived membership or strength of identification) and objective indicators (e.g., participation in community groups), with each approach capturing distinct aspects of social connectedness. Importantly, evidence suggests that mere membership in social groups can influence health and well-being, even when such memberships are not consciously salient, because groups provide platforms for accessing social, emotional, and practical resources, particularly during times of stress (e.g., Walsh et al. 2015). In this context, researchers have also distinguished between groups in which individuals are positioned by others (e.g., demographic or ascribed groups such as gender, ethnicity, or social class) and "acquired" groups. Acquired groups are those that individuals actively choose and participate in, such as community, religious, recreational, or professional groups. Membership in acquired groups has been shown to be particularly relevant for health, as these groups often provide normative, accessible, and sometimes invisible forms of support (Walsh et al. 2015). The present study adopts this latter approach by operationalizing MGM using attendance-based indicators of participation in community groups. This allows us to examine whether being embedded across multiple actively participated groups predicts physiological health outcomes independently of subjective identification.

MGM are particularly beneficial during key life transitions, such as entering university or retirement (Griffin et al. 2025; Iyer et al. 2009; Steffens et al. 2016) and in reducing feelings of distress following an adverse experience (Foran et al. 2025). A growing body of evidence supports the idea that "the more the merrier" applies to GM, with MGM consistently linked to better well-being (Iyer et al. 2009; Jetten et al. 2012) and lower mortality, especially among older adults (Minagawa and Saito 2015; Steffens et al. 2016). A study by Cruwys et al. (2013) found an effect of the number of social GM, finding that membership of social groups is both protective against developing depression and curative of existing depression. In short, existing research suggests that MGM can protect (self-reported) health during periods of stress. Though the relationship between MGM and objective indices of health is less clear. This paper aims to fill this gap.

Importantly, the health impact of MGM may depend not only on the number of groups to which an individual belongs, but also on the nature of those groups. It is especially relevant to consider the status of groups. Members of low-status groups may be exposed to systemic disadvantage due to their gender, race, ethnicity, or other social group memberships. For example, there is widespread cross-national evidence that discrimination is a pervasive feature of many women's lives (SteelFisher et al. 2019; UN Women and United Nations Department of Economic and Social Affairs 2023). In such cases, women's GM may increase exposure to discrimination and associated chronic stress, diminishing health benefits (Crenshaw 1991; Kellezi 2012).

Belonging to multiple minority groups can lead to cumulative stress. It has been empirically linked to poorer health outcomes. This is in part due to the additive effects of perceived discrimination across multiple social statuses (Bey et al. 2020; Cyrus 2017; Denise 2012, 2014). On the other hand, identification with a minority group buffers against some of the negative health impacts of discrimination (Branscombe et al. 1999). According to the Rejection Identification Model (RIM; Branscombe et al. 1999), this increased group identification in response to discrimination protects self-esteem and psychological well-being in the face of discrimination. However, when discrimination is perceived as personal rather than systemic, individuals are less likely to engage this protective mechanism and may instead internalize the experience, attributing it to personal inadequacies—a pattern linked to lower self-esteem and greater psychological distress (Crocker and Major 1989; Major and Dover 2015; Major et al. 2003). Although the present study did not include a measure of group identification, this wealth of literature offers a backdrop for the current study which examines whether MGM predicts subsequent objective indices of health in women and whether this relationship is moderated by the number of discrimination-attributed GM. That is, the group memberships that women perceive as being the basis for their experiences of discrimination.

Cardiovascular reactivity (CVR) provides a particularly informative and reliable measure of how the body physiologically responds to acute stress (Brindle et al. 2014). CVR refers to the magnitude of change in cardiovascular parameters, such as systolic and diastolic blood pressure (SBP and DBP, respectively) and heart rate (HR), from a resting baseline in response to an acute stressor. A substantial body of research demonstrates that individuals' cardiovascular responses to short-term psychological stress in laboratory settings, which is an index of physiological stress reactivity, predict long-term health outcomes (Chida and Steptoe 2010; Turner et al. 2020). When stress responses are chronically heightened or show very strong reactions across contexts, this pattern is described as an exaggerated cardiovascular response, which contributes to wear-and-tear on the vasculature and is associated with outcomes such as atherosclerosis and mortalityy (Barnett et al. 1997; Carroll et al. 2012, 2003, 1995; Matthews et al. 2006; Turner et al. 2020). More recently, research has demonstrated that relatively lower cardiovascular responses to acute stressors, often described in the literature as blunted reactivity, can also be maladaptive. Blunted cardiovascular reactivity has been linked to adverse cardiovascular outcomes in cardiac patients, and in healthy samples it is associated with behavioral and motivational dysregulation, including smoking, obesity, and depression (see systematic review O'Riordan et al. 2023). Physiologically, lower or blunted CVR may reflect downregulation of cardiac beta-adrenergic receptors or reduced metabolic responsiveness, both of which may undermine cardiovascular efficiency and long-term health. Laboratory-induced cardiovascular responses to stress have also been shown to meaningfully mirror reactions to real-world stressors (Kamarck et al. 2000; Turner et al. 1990), reinforcing their ecological validity. As such, a moderate, well-regulated stress response, characterized by an initial peak followed by recovery, is now considered most adaptive (McEwen 1998; McEwen and Seeman 1999; Whittaker et al. 2021).

There are currently no clear, consensus thresholds for defining "blunted" or "exaggerated" cardiovascular reactivity in the field. O'Riordan et al. (2023) conducted a comprehensive synthesis of laboratory stress studies and reported typical ranges of cardiovascular responses observed across different paradigms. These values provide helpful context for understanding how reactivity varies across tasks and samples but given that cardiovascular responses are shaped by a range of factors—task characteristics, methodological differences, and sample composition, applying fixed numerical thresholds to blunted or exaggerated reactivity may not be the most appropriate. In the present study, reactivity is therefore interpreted relative to the distribution within this sample, focusing on the pattern and magnitude of associations rather than categorical classifications. To understand whether MGM influences CVR, we draw on social identity approach to health. The Integrated Social Identity Model of Stress (ISIS; Haslam et al. 2004; Haslam and Reicher 2006) proposes that stress appraisals are shaped by one's group-based identities. More recently, the Social Identity Model of Stress Reactivity (SIMSR; Muldoon et al. 2026) suggests that both the number and nature of GM's influence physiological stress responses and health outcomes. Empirical research supports these theoretical claims. Regarding the nature of GM, Gallagher et al. (2014) showed that CVR increased when a task was framed in a way that highlighted group-relevant threat, demonstrating that it is the meaning attached to GM, rather than mere category membership, that shapes physiological responses. A related study found that student's SBP reactivity depended on the status related meaning of their university affiliation. Students from a lower-status university exhibited greater SBP reactivity when stress framing came from a higher status source. Conversely, students from a higher-status university showed greater SBP reactivity when the same message was delivered by an in group member (McMahon, Griffin, et al. 2024; McMahon, Walsh, et al. 2024). Evidence also supports the importance of the number of GMs. In a longitudinal study, university students who gained more social groups across the academic year exhibited a larger post-awakening cortisol response, indicative of a more adaptive ability to cope with stress (Griffin et al. 2025). In a large population based longitudinal study, greater MGM predicted better subsequent physical health via increased social networks and lower allostatic load (Gallagher et al. 2021). Together, this research suggests that both the meaning and number of group memberships can influence physiological health outcomes.

Discrimination is not only a social injustice but also a significant psychological stressor linked to acute and chronic physiological responses. Research shows that perceived discrimination activates stress systems, leading to elevated blood pressure, increased heart rate, and heightened cortisol levels (e.g., Richman et al. 2007; Sawyer et al. 2012). Women exposed to gender-based discrimination, such as sexist interactions or stereotype reminders, exhibit amplified physiological reactivity (Derks et al. 2011; Salomon et al. 2015; Townsend et al. 2011), while repeated exposure to discrimination contributes to dysregulated cardiovascular function (Panza et al. 2019). Discrimination also has profound psychological consequences, including increased depression, anxiety, and negative affect (Schmitt et al. 2014; Vargas et al. 2020), and is associated with adverse physical health outcomes such as arteriosclerosis and myocardial infarction (Udo and Grilo 2017). These findings highlight both the immediate and cumulative health burdens of discrimination.

Taken together, this suggests that the health impact of group memberships is shaped not only by the quantity of groups to which individuals belong, but also by the nature of those groups. Those tied to marginalized social positions or groups that experience discrimination are likely to be memberships that are more testing in terms of health. The number of groups participants perceived as the basis for their discriminatory experiences, discrimination-attributed GM, serves as a useful indicator of this burden. The benefit of this approach is that it moves beyond treating discrimination as a singular stressor, instead acknowledging that multiple attributions of discrimination may reflect multiple, intersecting stress exposures tied to different social status characteristics (Cobb et al. 2022; Denise 2012; Seng et al. 2012). Therefore, the influence of MGM on cardiovascular responses to stress, may depend in part on the number of group memberships people associate with discrimination. This underscores the need to consider both the potential benefits and the social burdens of MGM for people who hold potentially discriminated identities (Jetten et al. 2017; Muldoon et al. 2021).

Although gender and sex are frequently treated as a control variable in CVR research (e.g., Prabhavathi et al. 2014; Reckelhoff 2001), this practice can obscure important differences in how stress and discrimination are experienced across intersecting social identities. Sex-based differences in CVR have been documented (e.g., Martin et al. 2008; Whited and Larkin 2009), with some evidence suggesting that these differences may be influenced by the gender relevance of the stressor (e.g., Stroud et al. 2001). However, gender does not function in isolation. Black women, lesbian women, and other multiply marginalized groups report qualitatively distinct forms of discrimination, which have been linked to both heightened physiological stress responses and broader health disparities (Bowleg 2012; Lewis et al. 2014). Consistent with intersectionality theory (Collins et al. 2021; Crenshaw 1991), recent research shows that perceived discrimination based on multiple social identities, rather than a single axis like race or gender alone, is associated with worse mental and physical health outcomes (Bey et al. 2020; Denise 2012, 2014). For example, in a sample of healthy young women, Lepore et al. (2006) found that Black women showed a greater increase in diastolic blood pressure in response to a racial stressor compared to White women. Black women also had a slower heart rate during recovery after the racial stressor compared to the non-racial one. Black women who *attributed* the racial stressor to race had a larger increase in systolic blood pressure than those who did not. These findings highlight the need to account for the perceived reasons behind discriminatory experiences, whether singular or multiple, to more accurately capture the heath impact of discriminatory experiences. Accordingly, our study focuses on a women-only sample, centering gender as a meaningful social identity in CVR research, while the use of a discrimination attributed GM and a MGM measure accommodates an intersectional understanding of this phenomenon.

1 | The Present Study

A longitudinal approach was used, using data from the Midlife in the United States (MIDUS). We used a women-only sample,

as previous research has shown that experiences of discrimination are a common and chronic feature of many women's lives, and often shaped by intersecting identities such as race, sexuality, etc. Moreover, the benefits of MGM for individuals who report multiple groups attributed to discrimination are likely to be compromised. Repeated exposure to discrimination on the basis of group membership is likely to have a cumulative, negative effect on health and may undermine any protective effects afforded by MGM. Therefore, in this study we hypothesized that prior MGM affects later CVR for women. We further hypothesized that this relationship was moderated by number of discrimination-attributed GM, with those with higher number of GM's associated with discrimination evidencing least adaptive CVR. We did not specify a directional hypothesis regarding physiological reactivity. Both exaggerated and blunted reactivity have been described as maladaptive patterns of stress responding, reflecting overactivation or underactivation of physiological systems, respectively. Because prior literature does not consistently predict the direction of dysregulation across samples, we focused on the presence of maladaptive reactivity rather than its direction.

H1. *There is a significant effect of the amount of groups women report (MGM) and later cardiovascular response to stress.*

H2. *There is a significant effect of the amount of groups women report (MGM) and later cardiovascular response to stress, and this is moderated by discrimination-attributed GM.*

2 | Method

2.1 | Study Overview and Design

Our analysis used data obtained from various waves of the Midlife in the United States (MIDUS) data series. The data analysis plan and measures were pre-registered on the Open Science Framework (OSF; https://osf.io/8hfjn/?view_only=a575128854ee46ae8f271056acb77c24). The predictor MGM and the moderator variable number of discrimination-attributed GM were taken from MIDUS 2 survey data, which was collected in 2004. The MIDUS 3 Biomarker Project was conducted between 2017 and 2022, which collected biological samples and additional self-reported data. The outcome variable HR, DBP, and SBP reactivity were taken from the MIDUS 3 biomarker project, which was 13 to 18 years after the MGM and discrimination-attributed GM were collected. The covariates, education, race, blood pressure medication, BMI, age, smoker status, depression, and baseline cardiovascular value were taken from the MIDUS 3 and its related biomarker project. For the purposes of this study, we merged datasets from MIDUS 2 (Time 1), MIDUS 3, and the MIDUS 3 Biomarker Project (Time 2).

2.2 | Participants

The sample consisted of 179 women for the DBP and SBP data, and 200 with HR data, ages ranged from 47 to 94 ($M = 63.66$, $SD = 8.90$). Women who participated in the stress reactivity protocol for the MIDUS 3 Biomarker Project and had sufficient cardiovascular data to calculate at least one CVR parameter (i.e., SBP, DBP, or HR) during at least one baseline period and one stressor period were included in our analyses. Differences in sample size across cardiovascular parameters reflect measure-specific data quality and availability, as identified by MIDUS quality-control procedures. Participant characteristics for the sample are presented in the Table S1.

2.3 | Psychological Stress Procedure

Data collection for the Biomarker Project was completed at one of three locations: the University of California Los Angeles, the University of Wisconsin, and Georgetown University. The data collection site corresponded to where participants had completed the previous biomarker project. Data were processed at the Columbia University Medical Centre in the laboratory of Dr. Richard Sloan. The experimental psychophysiology assessment protocol took place in the morning of the second day of the clinic visit. Upon arrival, participants were fitted with the equipment required for data collection. They were provided with practice trials for the stress tasks before beginning the protocol. Participants first completed a seated baseline, during which they sat quietly for 11 min. This was followed by the first stress-inducing task, which lasted 6 min. After the initial task, participants rested for 6 min to recover before proceeding to a second 6-min stress task. The order of the stress tasks was randomized. The two stress tasks included the Stroop color-word interference task and the mental arithmetic challenge (MATH task). The Stroop task (MacLeod 1991) required participants to identify the colour of the letters in which a word was displayed, rather than the word itself. For example, participants might see the word “blue” displayed in red letters and use a keypad to select the colour of the letters (e.g., red) from four possible options: red, blue, yellow, or green. The MATH task (Turner et al. 1986, 1987) involved solving addition and subtraction problems displayed on a screen. Participants judged whether the provided answers were correct or incorrect. The difficulty of the task adjusted dynamically, beginning at an intermediate level (level 3) and increasing with accurate responses (up to level 5).

2.4 | Materials and Apparatus

2.4.1 | Cardiovascular Reactivity

To record SBP and DBP, a Finometer monitor (Finapres Medical Systems, Amsterdam, Netherlands) was used. The Finometer is a non-invasive device that is considered highly accurate for continuous blood pressure measurement (Schutte et al. 2004, 2003). The device uses a finger cuff placed on the participant's middle finger of their non-dominant hand to obtain continuous beat-to-beat readings. Additionally, a second cuff was positioned on the participant's upper arm on the same side. HR was measured using a beat-to-beat electrocardiogram (ECG). ECG electrodes were placed on the left and right shoulders, and in the left lower quadrant. Analog ECG signals were collected continuously and digitized at a sampling rate of 500 Hz using a 16-bit National Instruments analog-to-digital (A/D) board installed in a microcomputer. In the MIDUS 3 dataset, HR was calculated as the average of all valid HR intervals over a specified time period and expressed in beats per minute.

Reactivity values for each cardiovascular outcome (i.e., HR, SBP and DBP) were calculated by first averaging baseline measurements from the 11-min baseline period and then averaging measurements from the stress-task period (i.e., a 6-min Stroop task and a 6-min math task). Following prior research, reactivity to the two stress tasks was averaged to enhance reliability and generalizability (Kamarck et al. 2000, 2003; Turner et al. 1990). Reactivity scores for DBP were calculated by subtracting the mean DBP during the stress tasks from the baseline DBP, with the same procedure applied to HR and SBP. This approach aligns with previous studies using MIDUS data (e.g., Bibbey et al. 2013; Coyle et al. 2020; Creaven et al. 2020).

2.4.2 | Multiple Group Membership

Multiple group membership was assessed based on participants' reported attendance at four types of groups: religious meetings, unions/professional groups, sports/social groups, and other groups. The survey included an "other groups" category, but no qualitative information was collected on these groups, so we cannot report more detail. There were four items, an example item "In a typical month, about how many times do you attend meetings of sports or social groups?" Attendance was measured as the number of times per month participants engaged in these activities. For our analysis, the group membership was generated from 0 responses = not a member of a group, to attending which was (≥ 1) coded as having that group membership. The group memberships were summed to create the MGM variable, range 0–4.

2.4.3 | Discrimination-Attributed Group Memberships

All participants reported experiencing perceived discrimination. To assess discrimination-attributed GM, participants were asked to indicate the reason(s) for their discrimination from a predefined list of 10 group-level identity attributes commonly associated with discrimination: age, gender, race, ethnicity, religion, height/weight, appearance, physical disability, sexual orientation, and other. The prompt stated: "What was the main reason for the discrimination you experienced? (If more than one, check all that apply.)" Based on their responses, participants were categorized into three mutually exclusive groups according to their number of discrimination-attributed GM: (1) unattributed discrimination (no group selected), (2) one group, and (3) multiple groups (two or more groups selected).

2.5 | Covariates

All covariates were pre-registered and were taken from MIDUS 3 and its related Biomarker project. Covariates were chosen based on previous cardiovascular reactivity and cardiovascular health research, as well as those used in other MIDUS studies (e.g., McMahon, Griffin, et al. 2024; McMahon, Walsh, et al. 2024; Ryan et al. 2022). Education was comprised of three categories: high school or less, some college, and college degree or higher. Race ("white"/"non white"), blood pressure medication (yes/no), BMI, age, smoker status and depression were all entered as covariates in the analysis following usual practice (e.g., McMahon, Griffin, et al. 2024; McMahon, Walsh, et al. 2024) Former smokers were categorized as non-smokers (as used in previous research, e.g., Creaven et al. 2020). Depression symptoms were assessed using the 20-item Centre for Epidemiological Studies Depression Inventory (CESD; Radloff 1977). The items, example "I thought my life had been a failure", were measured on a 0 (Rarely or none of the time) to 3 (Most or all of the time) scale, with high scores indicating greater depressive symptoms.

2.6 | Approach to Analysis

All analyses were conducted using SPSS version 28. Participants who responded to either the Stroop task or the MATH task were included to maximize the amount of usable data. This approach was chosen to retain as much suitable data as possible, as several participants were missing data for either BP or HR. Participants were also required to have complete data for control variables from MIDUS 3 and for the MGM and number of discrimination-attributed GM from MIDUS 2. Extreme outliers, defined as values deviating $> \pm 3$ SDs from the mean cardiovascular reactivity scores, were excluded, as outlined in the pre-registration (HR reactivity, $n = 2$). Descriptive statistics for change in SBP, DBP, and HR across each experimental phase were first completed (see Table 1). Other descriptive statistics (such as frequency statistics for discrimination attributed GM; Table S2), selected options for discrimination attributed GM (Table S3), correlation Tables S5 and S6 and conceptual of the moderation relationship (Figure S1) are provided in the Supporting Information S1.

To examine if MGM (Time 1) effects future cardiovascular reactivity (Time 2), and if this relationship is moderated by the number of discrimination-attributed GM (Time 1), we used Hayes' PROCESS macro. Specifically, we employed PROCESS model 1 with 5000 bootstrapped samples (Hayes 2017) to conduct a moderation analysis separately for each outcome variable: SBP reactivity, DBP reactivity, and HR reactivity. For full moderation

TABLE 1 | Means (SD) cardiovascular parameters at baseline and stress task.

	SBP (mmHg) $N = 179$	DBP (mmHg) $N = 179$	HR (bpm) $N = 200$
Baseline	122.08 (20.8)	61.06 (12.88)	71.65 (9.97)
Task average	132.34 (22.59)	66.20 (13.27)	73.39 (9.97)
Stroop	133.94 (23.55)	66.95 (13.83)	72.49 (9.95)
Math	130.74 (22.39)	65.46 (13.05)	74.28 (10.20)

analysis results showing the covariates for each cardiovascular outcome (SBP, DBP and HR reactivity), see Table S7.

The moderating variable, discrimination-attributed GM, was coded as a multi categorical variable with three levels: unattributed discrimination (no group selected; reference category), one group, and multiple groups. To include this variable in the regression model, two dummy-coded variables were created: W1 (one group), where participants reporting one identity were coded as 1 and all others as 0; and W2 (multiple groups), where participants reporting multiple identities were coded as 1 and all others as 0. Two interaction terms were created by PROCESS model 1, MGM × one group and MGM × multiple groups. Supplementary analyses adjusting for MIDUS 3 multiple group membership and task completion status yielded comparable results (see Table S8).[1]

3 | Results

3.1 | HR Reactivity, MGM and Number of Discrimination-Attributed GM

Greater MGM at Time 1 significantly predicted lower HR reactivity at Time 2, $B = -0.66$, SE = 0.26, $p = 0.011$, 95% CI [−1.106, −0.192]. Given the relatively small HR increases observed in this sample (see Table 1), we interpreted lower reactivity as reflecting reduced physiological engagement during the task. The number of discrimination-attributed GM at Time 1 was not a significant predictor of HR reactivity at Time 2, for one group: $B = -0.03$, SE = 0.44, $p = 0.944$, 95% CI [−0.877, 0.861]; or multiple groups: $B = 0.25$, SE = 0.46, $p = 0.585$, 95% CI [−0.651, 1.127]. There was a significant moderation effect, MGM × one group: $B = 1.28$, SE = 0.38, $p = 0.001$, 95% CI [0.499, 2.022], whereby women who reported greater MGM and a single group membership as the basis for their discrimination at Time 1 had higher HR reactivity at Time 2, compared to those who attributed discrimination to multiple groups or had unattributed discrimination. There was no interaction effect for MGM × multiple groups: $B = 0.27$, SE = 0.40, $p = 0.491$, 95% CI [−0.434, 0.956]. See Figure 1 for interaction effects.

Conditional effects showed that for women who did not attribute discrimination to a group (unattributed discrimination) at Time 1, higher MGM at Time 1 was significantly associated with lower HR reactivity at Time 2, $B = -0.66$, SE = 0.26, $p = 0.011$, 95% CI [−1.164, −0.149]. For women who attributed discrimination to one GM at Time 1, higher MGM at Time 1 was significantly associated with higher HR reactivity at Time 2, $B = 0.62$, SE = 0.29, $p = 0.032$, 95% CI [0.053,1.188]. This suggests that higher MGM was only linked with a more engaged pattern of HR reactivity when discrimination was associated with one group. When discrimination was not attributed to a group, higher MGM was linked with lower responding. There was no significant association between MGM at Time 1 and HR reactivity at Time 2 when multiple groups for discrimination were reported at Time 1, $B = -0.39$, SE = 0.30, $p = 0.206$, 95% CI [−0.985, 0.214].

3.2 | DBP Reactivity, MGM and Number of Discrimination-Attributed GM[2]

There was no significant main effect for MGM at Time 1 on DBP reactivity at Time 2 ($B = 0.12$, SE = 0.41, $p = 0.759$, 95% CI [−0.641, 0.880]). Similarly, number of discrimination-attributed GM at Time 1 did not have a significant main effect on DBP reactivity at Time 2, whether participants reported one group ($B = 0.62$, SE = 0.76, $p = 0.418$, 95% CI [−0.919, 2.147]) or multiple groups ($B = 0.52$, SE = 0.80, $p = 0.516$, 95% CI [−1.018, 2.108]). There was no significant interaction effect between MGM and number of discrimination-attributed GM at Time 1 on DBP reactivity at Time 2 (MGM × one group: $B = 1.03$, SE = 0.63, $p = 0.103$,

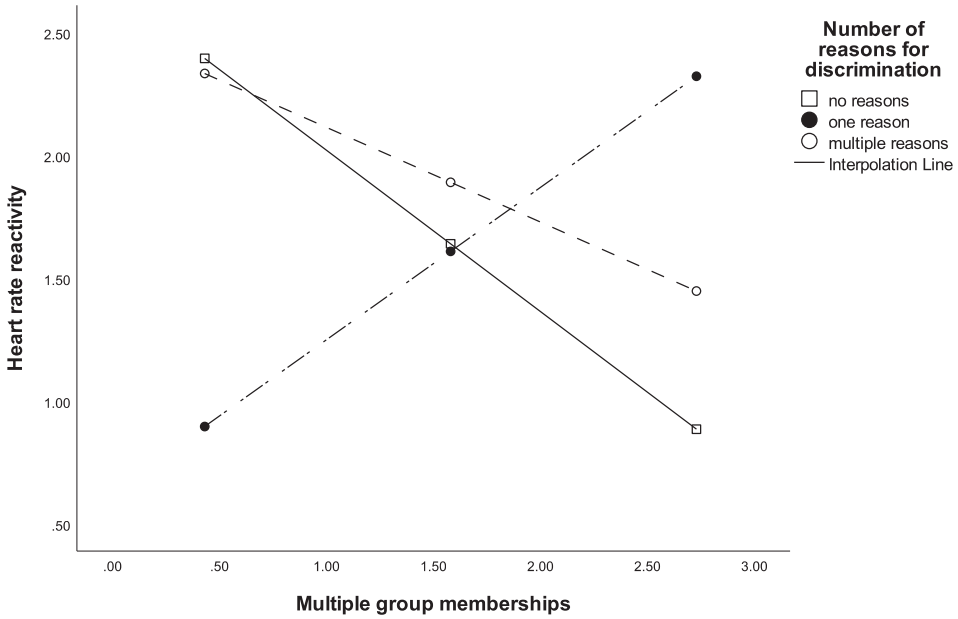

FIGURE 1 | Graph of interaction effect for number of discrimination-attributed group membership and multiple group membership for heart rate reactivity.

95% CI [−0.148, 2.194]; MGM × multiple groups: $B = 0.82$, SE = 0.64, $p = 0.205$, 95% CI [−0.332, 2.076]).

3.3 | SBP Reactivity, MGM and Number of Discrimination-Attributed GM

There was no significant main effect of MGM at Time 1 on SBP reactivity at Time 2, $B = 0.28$, SE = 0.96, $p = 0.767$, 95% CI [−1.93, 2.327]. Similarly, the number of discrimination-attributed GM at Time 1 was not significantly associated with SBP reactivity at Time 2, one group: $B = -1.59$, SE = 1.84, $p = 0.388$, 95% CI [−4.982, 1.963]; multiple groups: $B = -0.69$, SE = 1.91, $p = 0.718$, 95% CI [−4.387, 3.286]. Additionally, there was no significant moderation effect of the number of discrimination-attributed GM at Time 1 on the relationship between MGM at Time 1 and SBP reactivity at Time 2, MGM × one group: $B = 1.95$, SE = 1.51, $p = 0.197$, 95% CI [−0.793, 4.833], MGM × multiple groups: $B = 0.69$, SE = 1.54, $p = 0.657$, 95% CI [−2.203, 3.965].

4 | Discussion

In this longitudinal study, we examined whether women's MGM predicted future CVR, and whether this association was moderated by the number of discrimination-attributed group memberships. As noted earlier, there are no consensus thresholds for defining "blunted" or "exaggerated" CVR, and reactivity is best interpreted relative to the distribution within a given sample. In the present study, overall HR reactivity was relatively low, and greater MGM at Time 1 was associated with even lower HR reactivity at Time 2. Within this context, a lower response may reflect what has sometimes been referred to as "a blunted" physiological stress response that can occur in those who face chronic stress (Loeb et al. 2021). Although much of the literature highlights MGM as beneficial for health (e.g., Griffin et al. 2025), these benefits may be diminished under conditions of discrimination, where MGM can also expose individuals to cumulative or intersecting forms of disadvantage (e.g., Kyprianides et al. 2019). Supporting this interpretation, Foran et al. (2025) found that each additional discriminated group membership was associated with a greater likelihood of current long-COVID symptoms.

Notably, the number of discrimination-attributed GM at Time 1 did not independently predict HR reactivity, but there was a significant moderation effect. Specifically, among women who attributed discrimination to one group, higher MGM at Time 1 was significantly associated with higher HR reactivity at Time 2, suggesting a more adaptive, engaged physiological profile in this subgroup. While for women who had unattributed discrimination, higher MGM was significantly associated with lower HR response. No such relationship was found among those who reported multiple groups associated with discrimination. Finally, no significant effects were observed for SBP and DBP reactivity. These findings add to the growing literature addressing the call for more objective health measures in social identity research (Haslam et al. 2018; Steffens et al. 2021).

These findings offer a nuanced contribution to the social identity approach to health by demonstrating that one: MGM effects women's later HR reactivity, and that this relationship is moderated by how individuals interpret discrimination. In line with the social cure and wider social identity approach to health framework (e.g., Haslam et al. 2018; Jetten et al. 2012; Kellezi 2012), MGM may operate as a protective factor, but only under specific conditions. This aligns with the ISIS and SIMSR models, which suggest that social identity processes shape individuals' responses to stress. However, the absence of a similar effect in women who attribute discrimination to multiple group memberships underscores potential boundary conditions to the social cure.

Our findings contribute to the growing body of research on how cardiovascular responses to stress are shaped by social and group-related processes (e.g., Gallagher et al. 2014; McMahon, Griffin, et al. 2024; McMahon, Walsh, et al. 2024; Scheepers 2009; Scholl et al. 2018). Notably, we observed both a main effect and a moderation effect for HR reactivity. This is particularly important given that prior research has shown that relatively lower HR reactivity, often described in the literature as "blunted," has been identified as one of the most consistent predictors of adverse cardiovascular outcomes (O'Riordan et al. 2023).

Understanding how group-related factors influence physiological stress has important real-world implications, particularly among groups more vulnerable to stress-related conditions such as cardiovascular disease (CVD). Chronic stress is a major risk factor for CVD, increasing risk by 40%–50% (Steptoe and Kivimäki 2012), and is one of the leading causes of women's death globally (Woodward 2019). Importantly, women who also hold marginalized racial, ethnic, or sexual identities often experience compounded stress exposure and health disparities (e.g., López et al. 2021; Trinh et al. 2017), including being at greater risk of CVD (e.g., Mehta et al. 2023). Our findings suggest there are constraints to the health benefits of "MGM," specifically for those who possess multiple discriminated against identities. Future research should investigate further the boundary conditions of MGM as a platform for health, to inform development of appropriate intervention and campaigns.

Interpretating the findings through the wealth of RIM (Branscombe et al. 1999) literature may offer an explanation for why women in our study who did not associate their discrimination with a group membership showed relatively lower HR reactivity. Prior research supports this dynamic: group-based attributions for discrimination enhance ingroup identification, which in turn mitigates the negative psychological effects of discrimination (Bourguignon et al. 2006; Lee 2005; Schmitt et al. 2014), and strong group identification is associated with greater resilience, lower stress, and better health outcomes (Haslam et al. 2018). Future research would therefore benefit from incorporating identity-based measures, such as the In-Group Identification Measure (IGIM; Leach et al. 2008), which assess multiple dimensions of identification (e.g., self-definition and self-investment), to index the strength and quality of identification with discrimination-attributed groups. Incorporating such measures would allow future studies to examine whether variation in identification with these groups helps explain when multiple group memberships are associated with more adaptive versus maladaptive cardiovascular reactivity, thereby clarifying

the conditions under which MGM functions as a protective resource versus a marker of cumulative burden.

Our study has several strengths, particularly the use of a large, longitudinal secondary dataset. By analyzing data from the MIDUS study, we were able to explore our research question over time, allowing for the examination of potential cause-and-effect relationships (Caruana et al. 2015) between MGM, discrimination-attributed GM and later health outcomes, specifically CVR. Nevertheless, several limitations should be considered when interpreting the findings of this study. First, while prior literature has discussed patterns of relatively low or high cardiovascular reactivity, there are no agreed-upon validated thresholds for categorizing reactivity. In line with current standards, the present study interpreted reactivity continuously and relative to the sample distribution. Second, while secondary data analysis offers important advantages, including access to existing large-scale data, it also constrains analyses to the measures and design features available within the dataset. As a result, the present study relied on existing measures that may not fully capture the complexity of multiple group membership and related identity processes.

Another limitation is the reliance on the measures available in the dataset. Although we found a main effect of MGM on later HR reactivity, the findings are complex. Including a measure of strength of identification for both the groups in the MGM scale and those associated with perceived discrimination could help clarify our results, as prior research has shown that strong identification within groups is a key predictor of health and well-being (Kearns et al. 2018; Kinsella et al. 2018). However, because this was a secondary analysis of an existing dataset, identity-based measures of MGM were not available. Group membership was therefore operationalized using attendance-based indicators. While this approach has been used in prior research (e.g., Gallagher et al. 2021), it constrains the depth of the assessment of participants' group involvement (e.g., types of activities, availability and nature of support), their psychological identification with groups, or how participation was experienced, factors that may have provided deeper insight into the observed effects. Future research would benefit from incorporating more detailed and validated measures of group membership processes. In particular, the inclusion of tools such as the Exeter Identity Transition Scale would enable a more comprehensive assessment of participants' subjective identification with their groups and provide richer insight into the mechanisms at play.

Even with these limitations, the results still offer an important contribution to the social identity approach to health literature and align with the original social identity theory that mere group membership influences perception and behavior (Tajfel and Turner 1979) and is aligned with other studies that have found an effect for MGM using a similar approach (e.g., Cruwys et al. 2013; Jones and Jetten 2011).

Overall, these findings highlight the complex role of MGM in shaping women's physiological responses to stress. Crucially, this relationship is moderated by if women attribute discrimination to a GM. Our results extend the wider social identity approach to health literature by revealing important boundary conditions of the "more the merrier" model, particularly for individuals facing intersectional discrimination. While further research is needed to clarify when MGM confers benefits and how to leverage it in interventions, our findings underscore the value of examining social identity processes as mechanisms influencing women's stress responses at the physiological level.

Author Contributions

Aoife-Marie Foran: writing – review and editing, formal analysis, methodology, supervision. **Grace McMahon:** conceptualization, writing – review and editing, supervision. **Orla T. Muldoon:** conceptualization, writing – review and editing, writing – original draft, methodology, project administration, supervision, funding acquisition. **Lisa Skilton:** conceptualization, writing – original draft, writing – review and editing, methodology, formal analysis, visualization, project administration.

Acknowledgments

The authors wish to acknowledge grant funding from the European Research Council (Grant Agreement 884927).

Funding

This work was supported by the European Research Council (ERC) under an Advanced Grant (Grant agreement No. 884927) awarded to Prof Orla Muldoon. Dr. Aoife-Marie Foran has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement No 101034345.

Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

This study used data from the Midlife in the United States (MIDUS) Biomarker Project, funded by the National Institute on Aging. The cardiovascular response data are available through the Inter-university Consortium for Political and Social Research (ICPSR) at https://www.icpsr.umich.edu/web/NACDA/studies/4652. Access to biomarker data requires an application and a restricted data use agreement. Free registration with ICPSR is required.

Endnotes

[1] For results from moderation analyses involving the perceived discrimination scale, reported as part of a pre-registered secondary research question, see the Supporting Information S1.

[2] Supplementary analyses examined the robustness of the reported interaction effects by including multiple group membership at time 2 and task completion status as covariates. These sensitivity analyses did not alter the direction or substantive interpretation of the primary findings and are reported in full in the Table S8.

References

Barnett, P. A., J. D. Spence, S. B. Manuck, and J. R. Jennings. 1997. "Psychological Stress and the Progression of Carotid Artery Disease." *Journal of Hypertension* 15, no. 1: 49–55. https://doi.org/10.1097/00004872-199715010-00004.

Berkman, L. F. 1995. "The Role of Social Relations in Health Promotion." *Psychosomatic Medicine* 57, no. 3: 245–254.

Bey, G., S. Person, and C. Kiefe. 2020. "Gendered Race and Setting Matter: Sources of Complexity in the Relationships Between Reported

Interpersonal Discrimination and Cardiovascular Health in the CARDIA Study." *Journal of Racial and Ethnic Health Disparities* 7, no. 4: 687–697. https://doi.org/10.1007/s40615-020-00699-6.

Bibbey, A., D. Carroll, T. J. Roseboom, A. C. Phillips, and S. R. de Rooij. 2013. "Personality and Physiological Reactions to Acute Psychological Stress." *International Journal of Psychophysiology* 90, no. 1: 28–36. https://doi.org/10.1016/j.ijpsycho.2012.10.018.

Bourguignon, D., E. Seron, V. Yzerbyt, and G. Herman. 2006. "Perceived Group and Personal Discrimination: Differential Effects on Personal Self-Esteem." *European Journal of Social Psychology* 36, no. 5: 773–789. https://doi.org/10.1002/ejsp.326.

Bowleg, L. 2012. "The Problem With the Phrase Women and Minorities: Intersectionality—An Important Theoretical Framework for Public Health." *American Journal of Public Health* 102, no. 7: 1267–1273. https://doi.org/10.2105/ajph.2012.300750.

Branscombe, N. R., N. Ellemers, R. Spears, and B. Doosje. 1999. "The Context and Content of Social Identity Threat." In *Social Identity: Context, Commitment, Content*, edited by N. Ellemers, R. Spears, and B. Doosje, 35–58. Blackwell.

Brindle, R. C., A. T. Ginty, A. C. Phillips, and D. Carroll. 2014. "A Tale of Two Mechanisms: A Meta-Analytic Approach Toward Understanding the Autonomic Basis of Cardiovascular Reactivity to Acute Psychological Stress." *Psychophysiology* 51, no. 10: 964–976. https://doi.org/10.1111/psyp.12248.

Carroll, D., A. T. Ginty, G. Der, K. Hunt, M. Benzeval, and A. C. Phillips. 2012. "Increased Blood Pressure Reactions to Acute Mental Stress Are Associated With 16-Year Cardiovascular Disease Mortality." *Psychophysiology* 49, no. 10: 1444–1448. https://doi.org/10.1111/j.1469-8986.2012.01463.x.

Carroll, D., C. Ring, K. Hunt, G. Ford, and S. Macintyre. 2003. "Blood Pressure Reactions to Stress and the Prediction of Future Blood Pressure: Effects of Sex, Age, and Socioeconomic Position." *Psychosomatic Medicine* 65, no. 6: 1058–1064. https://doi.org/10.1097/01.psy.0000097330.58739.26.

Carroll, D., G. D. Smith, D. Sheffield, M. J. Shipley, and M. G. Marmot. 1995. "Pressor Reactions to Psychological Stress and Prediction of Future Blood Pressure: Data From the Whitehall II Study." *BMJ* 310, no. 6982: 771–775. https://doi.org/10.1136/bmj.310.6982.771.

Caruana, E. J., M. Roman, J. Hernández-Sánchez, and P. Solli. 2015. "Longitudinal studies." *Journal of Thoracic Disease* 7, no. 11: E537–E540. https://doi.org/10.3978/j.issn.2072-1439.2015.10.63.

Chida, Y., and A. Steptoe. 2010. "Greater Cardiovascular Responses to Laboratory Mental Stress Are Associated With Poor Subsequent Cardiovascular Risk Status: A Meta-Analysis of Prospective Evidence." *Hypertension* 55, no. 4: 1026–1032. https://doi.org/10.1161/hypertensionaha.109.146621.

Cobb, R. J., C. M. Sheehan, P. Louie, and C. L. Erving. 2022. "Multiple Reasons for Perceived Everyday Discrimination and All-Cause Mortality Risk Among Older Black Adults." *Journals of Gerontology: Series A* 77, no. 2: 310–314. https://doi.org/10.1093/gerona/glab281.

Collins, P. H., E. C. G. da Silva, E. Ergun, I. Furseth, K. D. Bond, and J. Martínez-Palacios. 2021. "Intersectionality as Critical Social Theory: Intersectionality as Critical Social Theory, Patricia Hill Collins, Duke University Press, 2019." *Contemporary Political Theory* 20, no. 3: 690–725. https://doi.org/10.1057/s41296-021-00490-0.

Coyle, D. K., S. Howard, A. Bibbey, S. Gallagher, A. C. Whittaker, and A.-M. Creaven. 2020. "Personality, Cardiovascular, and Cortisol Reactions to Acute Psychological Stress in the Midlife in the United States (MIDUS) Study." *International Journal of Psychophysiology* 148: 67–74. https://doi.org/10.1016/j.ijpsycho.2019.11.014.

Creaven, A. M., N. M. Higgins, A. T. Ginty, and S. Gallagher. 2020. "Social Support, Social Participation, and Cardiovascular Reactivity to Stress in the Midlife in the United States (MIDUS) Study." *Biological Psychology* 155: 107921. https://doi.org/10.1016/j.biopsycho.2020.107921.

Crenshaw, K. 1991. "Mapping the Margins: Intersectionality, Identity Politics, and Violence Against Women of Color." *Stanford Law Review* 43, no. 6: 1241–1299. https://doi.org/10.2307/1229039.

Crocker, J., and B. Major. 1989. "Social Stigma and Self-Esteem: The Self-Protective Properties of Stigma." *Psychological Review* 96, no. 4: 608–630.

Cruwys, T., G. A. Dingle, C. Haslam, S. A. Haslam, J. Jetten, and T. A. Morton. 2013. "Social Group Memberships Protect Against Future Depression, Alleviate Depression Symptoms and Prevent Depression Relapse." *Social Science and Medicine* 98: 179–186. https://doi.org/10.1016/j.socscimed.2013.09.013.

Cyrus, K. 2017. "Multiple Minorities as Multiply Marginalized: Applying the Minority Stress Theory to LGBTQ People of Color." *Journal of Gay & Lesbian Mental Health* 21, no. 3: 194–202. https://doi.org/10.1080/19359705.2017.1320739.

Denise, E. J. 2012. "Multiple Forms of Perceived Discrimination and Health Among Adolescents and Young Adults." *Journal of Health and Social Behavior* 53, no. 2: 199–214. https://doi.org/10.1177/0022146512444289.

Denise, E. J. 2014. "Multiple Disadvantaged Statuses and Health: The Role of Multiple Forms of Discrimination." *Journal of Health and Social Behavior* 55, no. 1: 3–19. https://doi.org/10.1177/0022146514521215.

Derks, B., D. Scheepers, C. Van Laar, and N. Ellemers. 2011. "The Threat vs. Challenge of Car Parking for Women: How Self- and Group Affirmation Affect Cardiovascular Responses." *Journal of Experimental Social Psychology* 47, no. 1: 178–183. https://doi.org/10.1016/j.jesp.2010.08.016.

Foran, A.-M., T. Cruwys, J. A. Rathbone, et al. 2025. "Multiple Group Membership and Trust Protect Against Distress in the Context of Unwanted Sexual Experiences at a Youth Mass Gathering." *Journal of Interpersonal Violence* 41, no. 5–6: 1015–1036.

Gallagher, S., S. Meaney, and O. T. Muldoon. 2014. "Social Identity Influences Stress Appraisals and Cardiovascular Reactions to Acute Stress Exposure." *British Journal of Health Psychology* 19, no. 3: 566–579. https://doi.org/10.1111/bjhp.12056.

Gallagher, S., O. T. Muldoon, and K. M. Bennett. 2021. "Multiple Group Membership, Social Network Size, Allostatic Load and Well-Being: A Mediation Analysis." *Journal of Psychosomatic Research* 151: 110636. https://doi.org/10.1016/j.jpsychores.2021.110636.

Griffin, S. M., A. Lebedová, T. Cruwys, et al. 2025. "Identity Change and the Transition to University: Implications for Cortisol Awakening Response, Psychological Well-Being and Academic Performance." *Applied Psychology. Health and Well-Being* 17, no. 1: e12608. https://doi.org/10.1111/aphw.12608.

Haslam, C., J. Jetten, T. Cruwys, G. Dingle, and S. A. Haslam. 2018. *The New Psychology of Health: Unlocking the Social Cure*. Routledge. https://doi.org/10.4324/9781315648569.

Haslam, S. A., J. Jetten, A. O'Brien, and E. Jacobs. 2004. "Social Identity, Social Influence and Reactions to Potentially Stressful Tasks: Support for the Self-Categorization Model of Stress." *Stress and Health: Journal of the International Society for the Investigation of Stress* 20, no. 1: 3–9. https://doi.org/10.1002/smi.995.

Haslam, S. A., and S. Reicher. 2006. "Stressing the Group: Social Identity and the Unfolding Dynamics of Responses to Stress." *Journal of Applied Psychology* 91, no. 5: 1037–1052. https://doi.org/10.1037/0021-9010.91.5.1037.

Hayes, A. F. 2017. *Introduction to Mediation, Moderation, and Conditional Process Analysis: A Regression-Based Approach*. Guilford publications.

Holt-Lunstad, J., T. B. Smith, and J. B. Layton. 2010. "Social Relationships and Mortality Risk: A Meta-Analytic Review." *PLoS Medicine* 7, no. 7: e1000316. https://doi.org/10.1371/journal.pmed.1000316.

Iyer, A., J. Jetten, D. Tsivrikos, T. Postmes, and S. A. Haslam. 2009. "The More (and the More Compatible) the Merrier: Multiple Group Memberships and Identity Compatibility as Predictors of Adjustment After Life Transitions." *British Journal of Social Psychology* 48, no. 4: 707–733. https://doi.org/10.1348/014466608X397628.

Jetten, J., N. R. Branscombe, S. A. Haslam, et al. 2015. "Having a Lot of a Good Thing: Multiple Important Group Memberships as a Source of Self-Esteem." *PLoS One* 10, no. 5: e0124609. https://doi.org/10.1371/journal.pone.0124609.

Jetten, J., C. Haslam, and S. H. Alexander. 2012. *The Social Cure: Identity, Health and Well-Being*. Psychology Press. https://doi.org/10.4324/9780203813195.

Jetten, J., C. Haslam, S. A. Haslam, and N. R. Branscombe. 2009. "The Social Cure." *Scientific American Mind* 20, no. 5: 26–33. https://doi.org/10.1038/scientificamericanmind0909-26.

Jetten, J., C. Haslam, S. A. Haslam, G. Dingle, and J. M. Jones. 2014. "How Groups Affect Our Health and Well-Being: The Path From Theory to Policy." *Social Issues and Policy Review* 8, no. 1: 103–130. https://doi.org/10.1111/sipr.12003.

Jetten, J., S. A. Haslam, T. Cruwys, K. H. Greenaway, C. Haslam, and N. K. Steffens. 2017. "Advancing the Social Identity Approach to Health and Well-Being: Progressing the Social Cure Research Agenda." *European Journal of Social Psychology* 47, no. 7: 789–802. https://doi.org/10.1002/ejsp.2333.

Jones, J. M., and J. Jetten. 2011. "Recovering From Strain and Enduring Pain: Multiple Group Memberships Promote Resilience in the Face of, Recovering From Strain and Enduring Pain Physical Challenges." *Social Psychological and Personality Science* 2, no. 3: 239–244. https://doi.org/10.1177/1948550610386806.

Kamarck, T. W., T. T. Debski, and S. B. Manuck. 2000. "Enhancing the Laboratory-To-Life Generalizability of Cardiovascular Reactivity Using Multiple Occasions of Measurement." *Psychophysiology* 37, no. 4: 533–542. https://doi.org/10.1111/1469-8986.3740533.

Kamarck, T. W., J. E. Schwartz, D. L. Janicki, S. Shiffman, and D. A. Raynor. 2003. "Correspondence Between Laboratory and Ambulatory Measures of Cardiovascular Reactivity: A Multilevel Modeling Approach." *Psychophysiology* 40, no. 5: 675–683. https://doi.org/10.1111/1469-8986.00069.

Kearns, M., O. T. Muldoon, R. M. Msetfi, and P. W. Surgenor. 2018. "Identification Reduces Stigma of Mental Ill-Health: A Community-Based Study." *American Journal of Community Psychology* 61, no. 1–2: 229–239. https://doi.org/10.1002/ajcp.12220.

Kellezi, B. 2012. "Social Cure or Social Curse?: The Psychological Impact of Extreme Events During the Kosovo Conflict." In *The Social Cure: Identity, Health and Well-Being*, edited by J. Jetten, C. Haslam, and S. A. Haslam, 217–233. Psychology Press.

Kinsella, E. L., O. T. Muldoon, D. G. Fortune, and C. Haslam. 2018. "Collective Influences on Individual Functioning: Multiple Group Memberships, Self-Regulation, and Depression After Acquired Brain Injury." *Neuropsychological Rehabilitation* 30, no. 6: 1059–1073. https://doi.org/10.1080/09602011.2018.1546194.

Kyprianides, A., M. J. Easterbrook, and T. Cruwys. 2019. ""I Changed and Hid My Old Ways": How Social Rejection and Social Identities Shape Well-Being Among Ex-Prisoners." *Journal of Applied Social Psychology* 49, no. 5: 283–294. https://doi.org/10.1111/jasp.12582.

Leach, C. W., M. Van Zomeren, S. Zebel, et al. 2008. "Group-Level Self-Definition and Self-Investment: A Hierarchical (Multicomponent) Model of In-Group Identification." *Journal of Personality and Social Psychology* 95, no. 1: 144–165. https://doi.org/10.1037/0022-3514.95.1.144.

Lee, R. M. 2005. "Resilience Against Discrimination: Ethnic Identity and Other-Group Orientation as Protective Factors for Korean Americans." *Journal of Counseling Psychology* 52, no. 1: 36–44.

Lepore, S. J., T. A. Revenson, S. L. Weinberger, et al. 2006. "Effects of Social Stressors on Cardiovascular Reactivity in Black and White Women." *Annals of Behavioral Medicine* 31, no. 2: 120–127. https://doi.org/10.1207/s15324796abm3102_3.

Lewis, T. T., D. R. Williams, M. Tamene, and C. R. Clark. 2014. "Self-Reported Experiences of Discrimination and Cardiovascular Disease." *Current Cardiovascular Risk Reports* 8, no. 1: 365. https://doi.org/10.1007/s12170-013-0365-2.

Loeb, E. L., A. A. Davis, R. K. Narr, B. N. Uchino, R. G. Kent de Grey, and J. P. Allen. 2021. "The Developmental Precursors of Blunted Cardiovascular Responses to Stress." *Developmental Psychobiology* 63, no. 2: 247–261. https://doi.org/10.1002/dev.21977.

López, J. D., A. Duncan, E. Shacham, and V. McKay. 2021. "Disparities in Health Behaviors and Outcomes at the Intersection of Race and Sexual Identity Among Women: Results From the 2011–2016 National Health and Nutrition Examination Survey." *Preventive Medicine* 142: 106379. https://doi.org/10.1016/j.ypmed.2020.106379.

MacLeod, C. M. 1991. "Half a Century of Research on the Stroop Effect: An Integrative Review." *Psychological Bulletin* 109, no. 2: 163–203. https://doi.org/10.1037/0033-2909.109.2.163.

Major, B., and T. L. Dover. 2015. "Attributions to Discrimination: Antecedents and Consequences." In *Handbook of Prejudice, Stereotyping, and Discrimination*, 213–239. Psychology Press.

Major, B., W. J. Quinton, and T. Schmader. 2003. "Attributions to Discrimination and Self-Esteem: Impact of Group Identification and Situational Ambiguity." *Journal of Experimental Social Psychology* 39, no. 3: 220–231. https://doi.org/10.1016/S0022-1031(02)00547-4.

Martin, E. A., S.-L. Tan, L. R. MacBride, S. Lavi, L. O. Lerman, and A. Lerman. 2008. "Sex Differences in Vascular and Endothelial Responses to Acute Mental Stress." *Clinical Autonomic Research* 18: 339–345. https://doi.org/10.1007/s10286-008-0497-5.

Matthews, K. A., S. Zhu, D. C. Tucker, and M. A. Whooley. 2006. "Blood Pressure Reactivity to Psychological Stress and Coronary Calcification in the Coronary Artery Risk Development in Young Adults Study." *Hypertension* 47, no. 3: 391–395. https://doi.org/10.1161/01.HYP.0000200713.44895.38.

McEwen, B. S. 1998. "Protective and Damaging Effects of Stress Mediators." *New England Journal of Medicine* 338, no. 3: 171–179. https://doi.org/10.1056/NEJM199801153380307.

McEwen, B. S., and T. Seeman. 1999. "Protective and Damaging Effects of Mediators of Stress: Elaborating and Testing the Concepts of Allostasis and Allostatic Load." *Annals of the New York Academy of Sciences* 896, no. 1: 30–47. https://doi.org/10.1111/j.1749-6632.1999.tb08103.x.

McMahon, G., S. M. Griffin, I. Borinca, D. Bradshaw, M. Ryan, and O. T. Muldoon. 2024. "Social Integration: Implications for the Association Between Childhood Trauma and Stress Responsivity." *Psychological Trauma* 16, no. Suppl 1: S133–S142. https://doi.org/10.1037/tra0001372.

McMahon, G., T. Walsh, S. M. Griffin, F. Houghton, and O. T. Muldoon. 2024. "Institutional Status and Identity Dimensions to Cardiovascular Stress Responses." *Journal of Community & Applied Social Psychology* 34, no. 1: e2712. https://doi.org/10.1002/casp.2712.

Mehta, L. S., G. P. Velarde, J. Lewey, et al. 2023. "Cardiovascular Disease Risk Factors in Women: The Impact of Race and Ethnicity: A Scientific Statement From the American Heart Association." *Circulation* 147, no. 19: 1471–1487. https://doi.org/10.1161/CIR.0000000000001139.

Minagawa, Y., and Y. Saito. 2015. "Active Social Participation and Mortality Risk Among Older People in Japan: Results From a Nationally Representative Sample." *Research on Aging* 37, no. 5: 481–499. https://doi.org/10.1177/0164027514545238.

Muldoon, O. T., R. D. Lowe, J. Jetten, T. Cruwys, and S. A. Haslam. 2021. "Personal and Political: Post-Traumatic Stress Through the Lens

of Social Identity, Power, and Politics." *Political Psychology* 42, no. 3: 501–533. https://doi.org/10.1111/pops.12709.

Muldoon, O. T., A. T. O'Donnell, A. M. Foran, et al. 2026. "The Social Identity Model of Stress Reactivity: An Integrated Model for Understanding Physiological Effects of Stress." *European Review of Social Psychology*: 1–38. https://doi.org/10.1080/10463283.2026.2631340.

O'Riordan, A., S. Howard, and S. Gallagher. 2023. "Blunted Cardiovascular Reactivity to Psychological Stress and Prospective Health: A Systematic Review." *Health Psychology Review* 17, no. 1: 121–147. https://doi.org/10.1080/17437199.2022.2068639.

Panza, G. A., R. M. Puhl, B. A. Taylor, A. L. Zaleski, J. Livingston, and L. S. Pescatello. 2019. "Links Between Discrimination and Cardiovascular Health Among Socially Stigmatized Groups: A Systematic Review." *PLoS One* 14, no. 6: e0217623. https://doi.org/10.1371/journal.pone.0217623.

Prabhavathi, K., K. Selvi, K. Poornima, and A. Sarvanan. 2014. "Role of Biological Sex in Normal Cardiac Function and in Its Disease Outcome–a Review." *Journal of Clinical and Diagnostic Research: JCDR* 8, no. 8: BE01–BE04. https://doi.org/10.7860/JCDR/2014/9635.4771.

Putnam, R. D. 2000. *Bowling Alone: The Collapse and Revival of American Community*. Simon Schuster.

Radloff, L. S. 1977. "The CES-D Scale: A Self-Report Depression Scale for Research in the General Population." *Applied Psychological Measurement* 1, no. 3: 385–401. https://doi.org/10.1177/014662167700100306.

Reckelhoff, J. F. 2001. "Gender Differences in the Regulation of Blood Pressure." *Hypertension* 37, no. 5: 1199–1208. https://doi.org/10.1161/01.HYP.37.5.1199.

Richman, L. S., G. G. Bennett, J. Pek, E. C. Suarez, I. Siegler, and R. B. Williams Jr. 2007. "Discrimination, Dispositions, and Cardiovascular Responses to Stress." *Health Psychology* 26, no. 6: 675–683. https://doi.org/10.1037/0278-6133.26.6.675.

Ryan, M., S. Gallagher, J. Jetten, and O. T. Muldoon. 2022. "State Level Income Inequality Affects Cardiovascular Stress Responses: Evidence From the Midlife in the United States (MIDUS) Study." *Social Science & Medicine* 311: 115359. https://doi.org/10.1016/j.socscimed.2022.115359.

Salomon, K., K. D. Burgess, and J. K. Bosson. 2015. "Flash Fire and Slow Burn: Women's Cardiovascular Reactivity and Recovery Following Hostile and Benevolent Sexism." *Journal of Experimental Psychology: General* 144, no. 2: 469–479. https://doi.org/10.1037/xge0000061.

Sawyer, P. J., B. Major, B. J. Casad, S. S. Townsend, and W. B. Mendes. 2012. "Discrimination and the Stress Response: Psychological and Physiological Consequences of Anticipating Prejudice in Interethnic Interactions." *American Journal of Public Health* 102, no. 5: 1020–1026. https://doi.org/10.2105/AJPH.2011.300620.

Scheepers, D. 2009. "Turning Social Identity Threat Into Challenge: Status Stability and Cardiovascular Reactivity During Inter-Group Competition." *Journal of Experimental Social Psychology* 45, no. 1: 228–233. https://doi.org/10.1016/j.jesp.2008.09.011.

Schmitt, M. T., N. R. Branscombe, T. Postmes, and A. Garcia. 2014. "The Consequences of Perceived Discrimination for Psychological Well-Being: A Meta-Analytic Review." *Psychological Bulletin* 140, no. 4: 921–948. https://doi.org/10.1037/a0035754.

Scholl, A., F. de Wit, N. Ellemers, A. K. Fetterman, K. Sassenberg, and D. Scheepers. 2018. "The Burden of Power: Construing Power as Responsibility (Rather Than as Opportunity) Alters Threat-Challenge Responses." *Personality and Social Psychology Bulletin* 44, no. 7: 1024–1038. https://doi.org/10.1177/0146167218757452.

Schutte, A., H. Huisman, J. Van Rooyen, N. Malan, and R. Schutte. 2004. "Validation of the Finometer Device for Measurement of Blood Pressure in Black Women." *Journal of Human Hypertension* 18, no. 2: 79–84. https://doi.org/10.1038/sj.jhh.1001639.

Schutte, A. E., H. W. Huisman, J. M. Van Rooyen, W. Oosthuizen, and J. C. Jerling. 2003. "Sensitivity of the Finometer Device in Detecting Acute and Medium-Term Changes in Cardiovascular Function." *Blood Pressure Monitoring* 8, no. 5: 195–201. https://doi.org/10.1097/00126097-200310000-00004.

Seng, J. S., W. D. Lopez, M. Sperlich, L. Hamama, and C. D. R. Meldrum. 2012. "Marginalized Identities, Discrimination Burden, and Mental Health: Empirical Exploration of an Interpersonal-Level Approach to Modeling Intersectionality." *Social Science & Medicine* 75, no. 12: 2437–2445. https://doi.org/10.1016/j.socscimed.2012.09.023.

SteelFisher, G. K., M. G. Findling, S. N. Bleich, et al. 2019. "Gender Discrimination in the United States: Experiences of Women." *Health Services Research* 54, no. Suppl 2: 1442–1453. https://doi.org/10.1111/1475-6773.13217.

Steffens, N. K., T. Cruwys, C. Haslam, J. Jetten, and S. A. Haslam. 2016. "Social Group Memberships in Retirement Are Associated With Reduced Risk of Premature Death: Evidence From a Longitudinal Cohort Study." *BMJ Open* 6, no. 2: e010164.

Steffens, N. K., C. J. LaRue, C. Haslam, et al. 2021. "Social Identification-Building Interventions to Improve Health: A Systematic Review and Meta-Analysis." *Health Psychology Review* 15, no. 1: 85–112. https://doi.org/10.1080/17437199.2019.1669481.

Steptoe, A., and M. Kivimäki. 2012. "Stress and Cardiovascular Disease." *Nature Reviews Cardiology* 9, no. 6: 360–370. https://doi.org/10.1038/nrcardio.2012.45.

Stroud, L. R., R. S. Niaura, and C. M. Stoney. 2001. "Sex Differences in Cardiovascular Reactivity to Physical Appearance and Performance Challenges." *International Journal of Behavioral Medicine* 8: 240–250. https://doi.org/10.1207/S15327558IJBM0803_6.

Tajfel, H., and J. C. Turner. 1979. "An Integrative Theory of Intergroup Conflict." In *The Social Psychology of Intergroup Relations*, edited by W. G. Austin and S. Worchel, 33–47. Brooks/Cole.

Townsend, S. S., B. Major, C. E. Gangi, and W. B. Mendes. 2011. "From 'in the Air' to 'Under the Skin': Cortisol Responses to Social Identity Threat." *Personality and Social Psychology Bulletin* 37, no. 2: 151–164. https://doi.org/10.1177/0146167210392384.

Trinh, M.-H., M. Agénor, S. B. Austin, and C. L. Jackson. 2017. "Health and Healthcare Disparities Among U.S. Women and Men at the Intersection of Sexual Orientation and Race/Ethnicity: A Nationally Representative Cross-Sectional Study." *BMC Public Health* 17, no. 1: 964. https://doi.org/10.1186/s12889-017-4937-9.

Turner, A. I., N. Smyth, S. J. Hall, et al. 2020. "Psychological Stress Reactivity and Future Health and Disease Outcomes: A Systematic Review of Prospective Evidence." *Psychoneuroendocrinology* 114: 104599. https://doi.org/10.1016/j.psyneuen.2020.104599.

Turner, J. R., S. S. Girdler, A. Sherwood, and K. C. Light. 1990. "Cardiovascular Responses to Behavioral Stressors: Laboratory-Field Generalization and Inter-Task Consistency." *Journal of Psychosomatic Research* 34, no. 5: 581–589. https://doi.org/10.1016/0022-3999(90)90033-Z.

Turner, J. R., J. K. Hewitt, R. K. Morgan, J. Sims, D. Carroll, and K. A. Kelly. 1986. "Graded Mental Arithmetic as an Active Psychological Challenge." *International Journal of Psychophysiology* 3, no. 4: 307–309. https://doi.org/10.1016/0167-8760(86)90039-5.

Turner, J. R., J. Sims, D. Carroll, R. K. Morgan, and J. K. Hewitt. 1987. "A Comparative Evaluation of Heart Rate Reactivity During MATH and a Standard Mental Arithmetic Task." *International Journal of Psychophysiology* 5, no. 4: 301–303. https://doi.org/10.1016/0167-8760(87)90061-4.

Udo, T., and C. M. Grilo. 2017. "Cardiovascular Disease and Perceived Weight, Racial, and Gender Discrimination in US Adults." *Journal of*

Psychosomatic Research 100: 83–88. https://doi.org/10.1016/j.jpsychores.2017.07.007.

UN Women & United Nations Department of Economic and Social Affairs. 2023. *Progress on the Sustainable Development Goals: The Gender Snapshot 2023*. UN Women. https://unstats.un.org/sdgs/gender-snapshot/2023/.

Vargas, S. M., S. J. Huey Jr., and J. Miranda. 2020. "A Critical Review of Current Evidence on Multiple Types of Discrimination and Mental Health." *American Journal of Orthopsychiatry* 90, no. 3: 374–390. https://doi.org/10.1037/ort0000441.

Walsh, R. S., O. T. Muldoon, S. Gallagher, and D. G. Fortune. 2015. "Affiliative and "Self-As-Doer" Identities: Relationships Between Social Identity, Social Support, and Emotional Status Amongst Survivors of Acquired Brain Injury (ABI)." *Neuropsychological Rehabilitation* 25, no. 4: 555–573. https://doi.org/10.1080/09602011.2014.993658.

Whited, M. C., and K. T. Larkin. 2009. "Sex Differences in Cardiovascular Reactivity: Influence of the Gender Role Relevance of Social Tasks." *Journal of Psychophysiology* 23, no. 2: 77–84. https://doi.org/10.1027/0269-8803.23.2.77.

Whittaker, A. C., A. Ginty, B. M. Hughes, A. Steptoe, and W. R. Lovallo. 2021. "Cardiovascular Stress Reactivity and Health: Recent Questions and Future Directions." *Psychosomatic Medicine* 83, no. 7: 756–766. https://doi.org/10.1097/PSY.0000000000000973.

Woodward, M. 2019. "Cardiovascular Disease and the Female Disadvantage." *International Journal of Environmental Research and Public Health* 16, no. 7: 1165. https://doi.org/10.3390/ijerph16071165.

Supporting Information

Additional supporting information can be found online in the Supporting Information section. **Table S1:** Characteristics of the sample used for analysis by cardiovascular function. **Table S2:** Number of discrimination-attributed GM selected for cardiovascular parameters. **Table S3:**. Selected discrimination-attributed GM. **Table S4:** Means (SD) for perceived discrimination by number of discrimination-attributed GM. **Table S5:** Correlation for heart rate (HR) reactivity and main variables ($N = 200$). **Table S6:** Correlation between systolic blood pressure (SBP) reactivity, diastolic blood pressure (DBP) reactivity and main variables ($N = 179$). **Figure S1:** Conceptual model of relationship between multiple group membership and cardiovascular reactivity, moderated by number of discrimination-attributed GM. **Table S7:** Main and interaction effects of multiple group membership and number of discrimination-attributed group memberships on cardiovascular parameters. **Table S8:** Main and interaction effects of multiple group membership and number of discrimination-attributed group memberships on cardiovascular parameters, including MGM at time 2 and task completion as covariate.