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Self-Rated Health and Inflammation: Associations among Partnered Sexual Minority and Heterosexual Adults

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Abstract

Objective: Self-rated health (SRH), as measured by a single item, is a well-established and remarkably robust predictor of morbidity and mortality, yet few studies have examined its biological correlates across diverse sexual orientation identities.

Methods: Using data from the population-representative National Couples Health and Time study (NCHAT) and its biospecimen sub-study (NCHAT-BIO), this study explored the relationship between LGBQ+ identity, SRH, and systemic inflammation. Among 3477 partnered (married or cohabiting) cisgender adults, 42.6% identified as LGBQ+ and a subset of 652 (41.3% LGBQ+) provided dried blood spot samples analyzed for IL-6 and C-reactive protein (CRP).

Results: In the full NCHAT sample, LGBQ+ respondents reported significantly poorer SRH than their heterosexual peers (LGBQ+ vs. Heterosexual: $t = 3.3574$, $df = 3466$, $p\text{-value} < 0.001$). In the NCHAT-BIO subsample, poorer self-rated health was significantly related to both higher IL-6 ($\beta = -0.23$, $SE = 0.042$, $p < 0.0001$) and higher CRP ($\beta = -0.41$, $SE = 0.054$, $p < 0.0001$), supporting the hypothesis that subjective health assessments may capture interoceptive awareness of inflammatory status. Importantly, the strength of the association between SRH and

inflammation did not differ across groups based on sexual orientation and gender (Interaction p-value for IL-6: 0.46, for CRP: 0.39). The associations between SRH and inflammatory markers were slightly attenuated after inclusion of key health and behavioral covariates, suggesting potential mediating factors warranting future investigation.

Conclusions: These findings replicate prior research on SRH and inflammation and extend them to LGBQ+ plus adults, underscoring the importance of inclusive health measurement. Given SRH's robust predictive power for future morbidity and mortality, integrating assessments of sexual orientation and biological markers offers critical insight for understanding and addressing health disparities.

Abstracto:

La autoevaluación del estado de salud (SRH, por sus siglas en inglés), medida mediante un solo ítem, es un predictor bien establecido y notablemente fiable de morbilidad y mortalidad; sin embargo, pocos estudios han examinado sus correlatos biológicos en personas con diversas identidades de orientación sexual.

Utilizando datos del Estudio Nacional de Parejas sobre Salud y Tiempo (NCHAT, por sus siglas en inglés) y su subestudio de muestras biológicas (NCHAT-BIO), este estudio exploró la relación entre la identidad LGBQ+, el SRH y la inflamación sistémica. Entre 3477 adultos cisgénero que vivían en pareja (casados o en cohabitación), el 42.6% se identificaron como LGBQ+, y un subconjunto de 654 (42.9% LGBQ+) proporcionó muestras de sangre seca que se analizaron para detectar IL-6 y proteína C reactiva (CRP, por sus siglas en inglés).

En la muestra completa de NCHAT, los participantes LGBQ+ informaron una SRH significativamente peor que sus pares heterosexuales (LGBQ+ frente a heterosexuales: $t=3.3574$, $df=3466$, valor $p<0.001$). En la submuestra de NCHAT-BIO, una peor SRH se relacionó significativamente con niveles más altos de IL-6 ($\beta=-0.22$, $EE=0.041$, $p<0.0001$) y de CRP ($\beta=-0.40$, $EE=0.055$, $p<0.0001$), lo que respalda la hipótesis de que las evaluaciones subjetivas de salud pueden reflejar la percepción interoceptiva del estado inflamatorio. Es importante destacar que la fuerza de la asociación entre la SRH y la inflamación no difirió entre los grupos según la orientación sexual y el género (valor p de interacción para IL-6: 0.54; para CRP: 0.45). Las asociaciones entre la salud autopercebida y los marcadores inflamatorios se atenuaron tras la inclusión de covariables clave de salud y comportamiento, lo que sugiere la existencia de posibles factores mediadores que justifican futuras investigaciones.

Estos hallazgos replican investigaciones previas sobre SRH e inflamación, y las extienden a personas adultas LGBQ+, lo que subraya la importancia de una medición de la salud inclusiva. Dado el sólido poder predictivo de la SRH para la morbilidad y la mortalidad, integrar evaluaciones de la orientación sexual y biomarcadores ofrece información crucial para comprender las disparidades en salud.

Keywords

self-rated health; inflammation; stress; psychological well-being; sexual minority; sexually diverse; LGBQ+; lesbian; gay; bisexual; heterosexual; health behaviors

1. Introduction

Self-rated health (SRH) is a robust indicator of future health outcomes, consistently predicting mortality as well as the onset of illnesses across a wide range of studies. The predictive value of SRH is independent of various established medical, behavioral, and psychosocial factors. Studies in this area include seminal work from Idler & Angel showing that a single global health rating independently predicted mortality in a large US sample (Idler & Angel, 1990). Over recent decades, the strong association between SRH, morbidity, and mortality has been consistently replicated across numerous studies and diverse populations (Andreasson et al., 2024; Benyamini, 2011; DeSalvo et al., 2006; Dramé et al., 2023; Idler & Benyamini, 1997; Jylha, 2009), including in a sample nearly 500,000 adults (Ganna & Ingelsson, 2015), confirming robustness and generalizability.

When assessing their subjective health, people use a range of information including general symptoms, physical functioning, mental well-being, and knowledge of their own health behaviors (e.g., diet, exercise, medication adherence, obesity status). Self-assessments may reflect underlying physiological functioning, including conditions that are sub-clinical and/or not yet diagnosed in a clinical setting. Of importance from a mechanistic perspective, low grade systemic inflammation may contribute to intuitive feelings of poor health (via effects on mood, energy, vague aches/pains) even before clinical symptoms manifest. In this manner, bodily sensations for which information is only available to the individuals themselves, can provide a unique source of information (Jylha, 2009).

These types of effects are well-documented in “cytokine-induced sickness behavior,” which is characterized by fatigue, low mood, and reduced motivation and can be triggered not only by infections but also by immune-activating treatments such as interferon-alpha therapy and chemotherapy (Dantzer & Kelley, 2007). These effects are mediated by proinflammatory cytokines including IL-6 which influence brain function via pathways including the vagus nerve and hypothalamic-pituitary-adrenal (HPA) axis (Dantzer, 2001; Konsman et al., 2002; Lasselin, 2021; Raison et al., 2006). Correspondingly, even in health individuals, subtle immune activity may influence self-ratings of health through neuroimmune signaling, contributing to mild but noticeable changes in mood, energy, and cognition.

Indeed, a growing body of empirical evidence supports an association between self-rated health and inflammation (Christian et al., 2011; Christian et al., 2013; Lekander et al., 2004; Majeno et al., 2024; Murdock et al., 2016; Shanahan et al., 2014; Tamura et al., 2018; Uchino et al., 2019; Uden et al., 2007; Warnoff et al., 2016). Data from 265 primary health care patients found that, among women, poorer self-rated health was associated with elevations in circulating proinflammatory cytokines including IL-6 and TNF- α , independent of age, education, physical health, and diagnoses (Lekander et al., 2004). Subsequently, in a study of 250 generally health older adults, we found that poorer self-rated health was associated with significantly higher serum levels of C-reactive protein (CRP), and interleukin (IL)-6 (Christian et al., 2011). These associations remained after controlling for age, body mass index, sex, objective health conditions, depressive symptoms, neuroticism, and health behaviors including smoking and physical activity, indicating that inflammatory status provides unique predictive information. These effects have further been replicated in

adolescents (Warnoff et al., 2016), young adults (Shanahan et al., 2014), as well as pregnant women (Christian et al., 2013), further supporting the hypothesis that individuals have an interoceptive sense of their inflammatory status based on factors such as general energy level, aches/pains, and other vague sensations that inflammation may ultimately affect.

Of health importance, adults who identify as lesbian, gay, bisexual, queer, or other non-heterosexual identities (LGBQ+) experience marked health disparities as compared to heterosexual adults, including heightened risk of developing cardiovascular diseases, depressive disorders, anxiety disorders, substance-use disorders, and suicidal ideation (Branstrom et al., 2016; Jackson et al., 2016; Malik et al., 2023; Rice et al., 2019). Further, in relation to self-rated health, population-level data demonstrate poorer self-rated health among LGBQ+ adults as compared to heterosexual individuals (Denney et al., 2013; Gonzales & Ehrenfeld, 2018; Institute of Medicine, 2011; Liu et al., 2013; Nelson et al., 2023; Reczek et al., 2017; Spiker, 2020). Mediating and moderating effects include structural and social factors, including socioeconomic status and state-level policies. In addition, Minority stress, stigma, and discrimination may contribute to poorer self-rated health by affecting psychological well-being, access to healthcare, and physiological stress responses (Christian et al., 2025; Flentje et al., 2022; Meyer, 2003). Indeed, our data show differences in inflammation in the context of anxiety and depressive symptoms based on sexual minority identity (Christian et al., in press), as well as associations between identify valence (i.e., positivity/negativity) and inflammation (Morgan et al., 2025). However, data are lacking on underlying biological correlates of self-rated health, which may also play a causal role.

Addressing gaps in knowledge, the current study examined LGBQ+ identity and self-rated health in a population-representative sample, the National Couples' Health and Time Study (Kamp Dush et al., 2023). In addition, associations with inflammation were examined in a subsample who participated in the Stress Biology Study (NCHAT-BIO) (Christian et al., 2026). Self-rated health data were available from 3,477 (42.6% LGBQ+), while inflammatory marker data (IL-6 and CRP) were available for a subset of 654 (42.8% LGBQ+). We hypothesized that LGBQ+ individuals would report poorer self-rated health than their heterosexual counterparts. Further, we hypothesized that poorer self-rated health would be associated with greater inflammation, as indicated by levels of IL-6 and CRP. Finally, as described above, factors contributing to self-rated health are multi-factorial and can vary based on demographic characteristics. Thus, we examined the extent to which associations between LGBQ+ identity, self-rated health, and inflammation were influenced by physical health conditions, mental health (anxiety, depressive symptoms), and health behaviors/indicators (obesity, smoking, and alcohol use).

2. Methods

2.1 Study Cohort.

Full details on the study design and methodology of the National Couples Health and Time Use Study (NCHAT) are available at Kamp Dush et al., 2023. The National Couples Health and Time Use Study (NCHAT) includes 3,642 main respondents, ≥18 years of age, who are married or cohabiting (living together). Among main respondents, 1,621 (44.5%)

adults self-identified as gay, lesbian, bisexual, or a different identity (e.g., genderqueer, non-binary). NCHAT also targeted recruitment of people who were racial/ethnic minorities, with a final distribution of main respondents of 61.7% non-Hispanic White, 9.2% non-Hispanic Black, 5.7% non-Hispanic Asian, 16.1% Hispanic, and 7.5% other people of color. Data were evenly split between those assigned male at birth and those assigned female at birth. Participants were recruited nationally by Gallup. Each completed a 45-minute survey online. Prepaid and postpaid incentives were provided. Data were collected in English and Spanish.

Analyses related to self-rated health were conducted on the overall NCHAT cis-gender main respondents, resulting in a sample of 3,477 respondents. For analyses specific to the biological markers, inclusion criteria included cisgender identity and participation in the NCHAT Stress Biology study (NCHAT-BIO), a sub-study of NCHAT supported by the National Institute on Minority Health and Health Disparities (NIMHD) in which blood samples were collected from a subsample of main respondents, as detailed below. The NCHAT-BIO study was approved by the Ohio State University Biomedical Institutional Review Board.

2.2 Sociodemographic and health indicators.

Sociodemographic and health characteristics were measured via self-report including age, racial/ethnic identity, income, education, body mass index based on weight and height, and tobacco use. Gender identity and sexual orientation were assessed as detailed below.

Gender Identity. Respondents reported their gender identity from five options, including woman, man, trans woman, trans man, and “do not identify as any of the above”. We excluded those who identified as transgender or “do not identify as any of the above” from the current analyses due to insufficient numbers for analysis. Thus, all participants in the current analyses were cisgender.

Sexual orientation. In terms of sexual orientation, NCHAT includes the following question: “What do you consider yourself to be? Select all that apply” with 11 response options: heterosexual or straight, gay or lesbian, bisexual, same-gender-loving, queer, pansexual, omnisexual, asexual, don’t know, questioning, and “something else,” with an option to specify. We coded respondents into two mutually exclusive categories: heterosexual (heterosexual or straight) and sexual minority (gay or lesbian, bisexual, same-gender-loving, queer, pansexual, omnisexual, asexual, don’t know, questioning, and “something else”).

2.3 Self-Report Measures.

Self-Rated Health. Global self-rated health was assessed using a single item measure from the RAND Health Survey developed for the Medical Outcomes Study (Ware & Sherbourne, 1992). The single item asks, “In general, would you say your health is: Excellent, Very Good, Good, Fair, or Poor”. This item was coded so that a higher score indicated better health (from 5 = Excellent to 1 = Poor).

Depressive symptoms were assessed using the **Center for Epidemiologic Studies Depression (CES-D-10)** (Andresen et al., 1994) scale which included 10 items which asked participants, “How often have you felt this way in the past 7 days?” with regard to emotional, interpersonal, and somatic symptoms of depression. Participants responded to each item by reporting on a 4-item Likert scale ranging from 0 (rarely or none of the time, less than 1 day) to 3 (most or all of the time, 5–7 days). The Cronbach’s alpha within the NCHAT-BIO subsample was 0.86.

Sleep Quality was assessed using a single item measure from the PROMIS Adult Assessment, which inquires, “In the past week, my sleep quality was:” with options from 1 (Poor) to 5 (Excellent).

2.4. Health conditions/menopausal status.

The total number of health conditions were coded by asking participants about the presence of the following: arthritis, rheumatoid arthritis, gout, lupus, or fibromyalgia; asthma; blood clots in legs or lungs; cancer or a malignancy of any kind; chronic obstructive pulmonary disease (COPD); Crohn’s disease or ulcerative colitis; diabetes; emphysema; heart attack; heart condition, heart disease, or angina; high cholesterol; high blood sugar; hypertension (high blood pressure); kidney disease; liver disease; menopause; osteoporosis or loss of bone density; perimenopause; prediabetes, impaired fasting glucose, impaired glucose tolerance, borderline diabetes, or high blood sugar; sleep disorder (e.g., insomnia or sleep apnea); stroke; thyroid problems; an ulcer.

2.5 Dried Blood Spot Collection.

As detailed in the NCHAT-BIO methodology report, (Christian et al., 2026) all NCHAT primary respondents (n = 3,642) and 368 partners were invited to participate in NCHAT-BIO. Note: Although we briefly permitted partners to participate, due to budget constraints we subsequently moved to only sampling main respondents. Of those invited, 1,220 primary respondents and 138 partners completed the online consent. Some people who consented were not sent a DBS kits because 1) they failed to provide adequate contact information for mailing or 2) data collection was discontinued after reaching funding limits. Thus, DBS kits were mailed to 1,161 primary participants and 130 partners.

Overall, DBS were returned from 950 people representing 880 different dyads (810 from one person in a couple and 70 from both people in the couple). For selection of those to be assayed, individuals reporting HIV or AIDS, unknown HIV status, or current cancer (n=69) were excluded because these conditions and their treatments can affect the immune parameters being measured. In addition, if both individuals in a couple provided a DBS, only one was assayed, avoiding statistical concordance. An additional 24 individuals were excluded from assay due to an error in data processing which resulted in them being incorrectly identified as ineligible for assay. Ultimately, 787 samples were assayed. Of the 787 participants for whom samples were assayed, 687 had valid IL-6 and/or CRP values. In addition, those from transgender or non-binary identity or other identity (n=35) were excluded from the current statistical analyses resulting in a final sample of 652. Biological outliers (results $\pm$ 3 SD from the mean, n = 4 for IL-6 and n = 3 for CRP) were further

excluded from analyses, resulting $n = 630$ for CRP analysis and $n = 429$ for IL6 analysis. Analyses to examine differences among participants with available data versus not on IL-6 and CRP demonstrated that those with IL-6 were on average older (43.76 vs. 42.01, $p = 0.034$) than those without IL-6 data. In addition, those with CRP data had on average higher BMI (29.97 vs. 25.17, $p < 0.001$), and lower average SRH (3.33 vs. 3.91, $p = 0.009$).

Participation involved self-collection of finger stick dried blood spot (DBS) samples. Participants were given consent information, including details about the establishment of the NCHAT-BIO repository for future research. Gallup sent participants collection packets (lancets, DBS collection card, alcohol wipe, gauze, bandages, and pre-paid return envelope) and a \$5 pre-paid incentive. To support quality data collection, a tailor-made professional 5-minute video tutorial was made available in English and with English and Spanish subtitles. The video was supplemented with written/pictorial instructions matching the video. Participants were instructed to collect DBS at least two weeks removed from any acute illness (e.g., cold, flu, COVID) or vaccination. Participants were instructed to collect samples between 8 AM and 12 PM and to record sample collection time on the front of the dried blood spot collection card. Among the 652 providing DBS in this study, 76.5% of participants recorded a collection time between 8AM and 12PM, 16.5% recorded a time outside of this window, and 7.0% did not record a collection time. Thus, the vast majority of samples were collected in the morning, limiting effects of diurnal variation on outcomes of interest.

Consistent with social psychology research, per Gallup's extensive prior experience, provision of a pre-incentive greatly increases follow-through via effects of reciprocity (Scherpenzeel & Toepoel, 2012). After participants returned the completed DBS via pre-paid return envelope to the Ohio State University, they received an additional \$20 incentive, sent by Gallup to maintain confidentiality. All data were delivered to researchers in a de-identified manner. The only master list is securely maintained at Gallup.

2.6 Assays for IL-6 & CRP.

Samples were analyzed for IL-6 and CRP using highly sensitive immunoassay protocols validated for use with DBS samples at Northwestern University's Laboratory for Human Biology Research (McDade et al., 2004; McDade et al., 2021). Briefly, 3×5 mm punches of the DBS sample, calibration material, and controls were eluted in 50 μ L buffer overnight in a filter plate (Millipore Multi-Screen MSHVN4510) and transferred to 96-well assay plates for IL-6 (Meso Scale Diagnostics V-PLEX Human Cytokine; K151AOH) and quantified on the Sector Imager 2400. A 4-parameter logistic curve was fitted to the signal and calibrator concentration data to calculate unknowns. CRP was quantified in DBS samples using a high sensitivity enzyme immunoassay protocol previously developed for use with DBS, using 1×3.2 mm disc eluted in 250 μ L assay buffer (McDade et al., 2004). Absorbance was read at 490nm on 96 well spectrophotometer platereader (BioTek ELx808). To minimize between-assay variation, all samples were analyzed by the same technician using a single lot of reagents, and samples were distributed randomly across assay plates.

2.7 Statistical Analyses.

Sociodemographic and health characteristics, inflammation markers, psychosocial self-report measures, and other self-reported health behaviors were compared across sexual orientation and gender identity groups using two-sample t-test, chi-square tests, and Wilcoxon-rank sum tests as appropriate. Natural log (ln) transformation was performed on inflammation markers to better approximate the normality of residuals. Linear regression models were used to examine differences in self-rated health across sexual orientation and gender identity groups, first in the full NCHAT sample (using weighted linear regression with the NCHAT survey design weights), and then in the NCHAT-BIO sample (unweighted). The associations between self-rated health and inflammation markers were evaluated using a series of linear regression models with inflammatory markers as the outcomes. Initial analyses were unadjusted, and subsequent models were incrementally adjusted for potential confounders. Age, body mass index (BMI), comorbidities, and gender were included first, followed by depressive symptoms, and finally health behaviors (smoking status, alcohol use, and sleep quality). A two-sided significance level of $\alpha=0.05$ was used for all tests. Analyses were performed in R version 4.2.1. The present study was not preregistered. All analyses should be considered exploratory and hypothesis-generating.

Results

3.1 Participant Characteristics.

Weighted estimates of demographic characteristics using the full NCHAT-cohort are presented in Table 1. These estimates are population representative. Characteristics (unweighted) of the NCHAT-BIO subsample are provided in Table 2. Differences between the four groups in NCHAT-BIO were observed in age, number of health conditions, depressive symptoms, alcohol use, and CRP levels ($p \leq 0.05$). Marginal differences were also observed in sleep quality ($p = 0.065$) and BMI ($p = 0.10$). Within the NCHAT-BIO subsample, groups did not differ in smoking, self-rated health, or IL-6. Correlations among key variables are shown in Table 3. As shown, significant associations among key variables including IL-6, CRP, self-rated health, BMI, health conditions, and depressive symptoms were observed, as expected, supporting data validity.

3.2 Self-Rated Health by Gender and Sexual Orientation.

Self-rated health by gender and sexual orientation in the full NCHAT sample is shown in Figure 1. Survey-weighted linear regression analyses were used to examine whether groups differed in global self-rated health. Results of unadjusted models showed global self-rated health was significantly different across groups based on sexual orientation and gender ($p = 0.0008$, $R^2 = 0.0059$). In a model examining main effects of gender, main effects of sexual orientation, and the interaction between the two factors, there was no significant interaction ($p = 0.18$, $R^2 = 0.0059$). After removing the interaction, there was not a significant main effect of gender on SRH ($p = 0.20$, Cohen's $d = -0.062$). However, there was a significant main effect of sexual orientation such that mean SRH was lower among sexual minority compared to heterosexual respondents (3.11 vs. 3.40, $p = 0.001$, Cohen's $d = 0.31$).

These analyses were repeated in the subsample of 652 individuals who also provided biological data. In this subgroup, which was not population-representative, unadjusted linear regression analyses did not show significant differences across groups based on sexual orientation ($p = 0.59$, Cohen's $d = 0.035$) or gender ($p = 0.41$, Cohen's $d = -0.061$).

3.3 Self-Rated Health and Inflammation.

Next, linear regression models were used to examine the association between self-rated health and both IL-6 and CRP in the subset of participants who provided biological samples (Fig 2; Table 4). Results of unadjusted analyses showed that poorer self-rated health was significantly associated with both higher IL-6 ($B = -0.23$, $SE = 0.042$, $p < 0.0001$, $R^2 = 0.064$) and higher CRP ($B = -0.41$, $SE = 0.054$, $p < 0.0001$, $R^2 = 0.081$). The relationships between self-rated health and inflammation were similar across groups based on sexual orientation and gender (Interaction p -value for IL-6: 0.46, for CRP: 0.39).

3.4 Self-Rated Health and Inflammation Adjusting for Key Covariates.

Further linear regression analyses examined the association between self-rated health and inflammation, controlling for age, gender, BMI, and number of comorbidities (Table 4). These analyses showed that, after including these controls, associations of higher self-rated health with both lower CRP and lower IL-6 were marginally attenuated (CRP: $B = -0.10$, $SE = 0.055$, $p = 0.067$, $R^2 = 0.32$; IL-6: $B = -0.08$, $SE = 0.046$, $p = 0.081$, $R^2 = 0.21$).

In further linear regression analyses (Table 4), controlling for depressive symptoms (CES-D scores) as well as the above covariates (age, gender, BMI, and comorbidities), the associations of self-rated health with CRP and IL-6 was still negative, but further marginally attenuated (CRP: $B = -0.094$, $SE = 0.058$, $p = 0.10$, $R^2 = 0.32$; IL-6: $B = -0.076$, $SE = 0.048$, $p = 0.12$, $R^2 = 0.21$). Finally, linear regression analyses were conducted adjusting for the above covariates as well as health behaviors: smoking, alcohol use, and sleep quality (Table 4). Results showed that the association between self-rated health and CRP was further reduced ($B = -0.09$, $SE = 0.060$, $p = 0.14$, $R^2 = 0.32$). The association between self-rated health and IL-6 was minimally affected ($B = -0.085$, $SE = 0.049$, $p = 0.081$, $R^2 = 0.23$).

4. Discussion

To address existing gaps in the literature, this study explored the association between LGBQ+ identity and self-rated health using a population-representative sample, and examined associations with inflammation in a subsample. Consistent with our hypotheses, in the overall NCHAT sample, LGBQ+ individuals reported poorer self-rated health compared to their heterosexual peers. Further, in the subset of participants who participated in NCHAT-BIO, poorer self-rated health was associated with inflammation as indicated by elevations in both IL-6 and CRP. The magnitude of the association between inflammation and self-rated health was similar among LGBQ+ and heterosexual adults.

First, this study demonstrates that LGBQ+ adults report significantly poorer self-rated health than heterosexual respondents. Notably, NCHAT is a population-representative sample of partnered adults in the US who come from all 50 states, replicating prior findings in a more robust sample. Many prior studies demonstrating poorer self-rated health among sexual

minority adults (e.g., Denney et al., 2013; Liu et al., 2013; Reczek et al., 2017; Spiker, 2020) have used the National Health Interview Survey (NHIS) which uses the gender identity of partners as a proxy for sexual orientation, thus bisexual respondents who are partnered with someone of a different gender were not identified as LGBTQ+. Other studies use the Behavioral Risk Factor Surveillance System (Conron et al., 2010; Gonzales & Ehrenfeld, 2018; Liu et al., 2013; Nelson et al., 2023) which only allows for the examination of sexual orientation in states that opt in to asking sexual orientation questions – in 2023, 35 states included the module (Division of Population Health, 2025) but those that did not were some of the least protective states for LGBTQ+ adults such as Arkansas and Mississippi (Movement Advancement Project, 2022). Other studies have used small, less statistically powered subsamples within larger studies such as the Health and Retirement Study (Liu et al., 2021). This study does replicate a Swedish population representative sample that had full coverage of the country between 2008 and 2013 (Bränström et al., 2016). Swedish lesbian, gay, and bisexual individuals reported poorer self-rated health than heterosexual individuals. Of note, the difference in self-rated health found in NCHAT was not observed in the NCHAT-BIO subsample which is smaller, highlighting the importance of a robust sample size. Thus, the current study provides an important replication and extension of prior findings.

The second key finding from this study is that self-rated health is associated with inflammation in terms of both CRP and IL-6, with similar magnitude of effects regardless of sexual orientation. Self-rated health has previously been associated with inflammation in a number of studies, including investigations of older adults, young adults, adolescents, and pregnant women (Andreasson et al., 2012; Arnberg et al., 2016; Christian et al., 2011; Christian et al., 2013; Kananen et al., 2021; Shanahan et al., 2014; Tanno et al., 2012; Warnoff et al., 2016). Via replication in LGBTQ+ adults, this study provides novel support for the generalizability of the association between self-rated health and inflammation, further bolstering the robust nature of a single-item measure of self-rated health. As only a subsample of NCHAT participated in the NCHAT-BIO, and those with versus without biological markers of interest differed in age, BMI, and SRH, future replication in a larger sample would bolster these findings.

When models linking self-rated health and inflammation were adjusted for BMI, age, health conditions, and sex, associations for both IL-6 and CRP were modestly attenuated whereby effects were no longer present at a p value < 0.05 . Similarly, models were modestly attenuated by inclusion of depressive symptoms, smoking, alcohol, and sleep. These factors likely contribute to the link between SRH and inflammation via at least two pathways. First, individual's knowledge of the presence of an unhealthy behavior (e.g., smoking) may lead them to rate their health more poorly. In addition, and concurrently, the unhealthy behavior may promote inflammation and therefore enhance interoceptive cues of unwellness. Thus, these factors may serve as mediating factors rather than simply “confounds”. Because these factors tend to be inter-correlated (e.g., depressive symptoms and obesity), disentangling the unique effects of a given factor is not possible given the cross-sectional design.

One limitation of the current study is that all participants were married or cohabiting, limiting generalizability. The average levels of mental health, physical health and self-rated

health may be higher than observed in the general population because there are numerous studies showing that single individuals often fare worse than their partnered counterparts across a wide array of outcomes (Frech & Williams, 2007; Liu & Umberson, 2008; Musick & Bumpass, 2012; Wang et al., 2020). There are some complexities in this body of work that include whether individuals are in a first marriage or remarriage (Hsu & Barrett, 2020), cohabiting versus married (Musick & Bumpass, 2012) and differentiating the effect of divorce or widowhood rather than never being married (Kalmijn, 2017; Marks & Lambert, 1998). An overarching issue in this body of work is whether selection is operating, such that healthy individuals are more likely to form relationships and, as a result, the partnered population appears healthier (Brown et al., 2012). Thus, there is some debate about whether marriage or union formation itself causes better health.

A review of studies that found that marriage was associated with health benefits for the LGBTQ+ population; this review relied on data largely preceding the passage of the Obergefell v. Hodges in 2015 (Karney et al., 2024). However, marriage is not always associated with improved health benefits, as shown in analysis of self-rated health in the National Health Interview Study (2013–2014) data comparing married, cohabiting, never married and previously married gay and lesbian respondents (Reczek et al., 2017). Further, a study based on the National Health Interview Survey 2013–2017 indicated that marriage was protective of physical health (self-reported health and functional limitations) for individuals who identified as heterosexual, gay or lesbian, but married bisexual men and women reported poorer health than their unmarried counterparts (Hsieh & Liu, 2019). Recent research focusing on LGB populations since marriage to same-sex couples has been legal across the United States is limited and finds that married or partnered individuals experience better mental health and physical health (self-rated health or physical health limitations)(Akré et al., 2025; Goldsen et al., 2017; Kamp Dush & Manning, 2022; Song, 2025). Analysis of lesbian, gay and bisexual men and women's psychological distress shows that partnered lesbian women fared better than their unpartnered counterparts, but partnership status was not associated with psychological distress for bisexual women, gay or bisexual men (Wilson et al., 2022). Future studies inclusive of unpartnered individuals would help to elucidate unique effects of being partnered within our models.

Another limitation of this study is that it is cross-sectional in design, rather than longitudinal. Although poorer SRH is reliably linked to higher inflammation in cross-sectional studies, this relationship is far less consistent in available longitudinal studies. For example, a study of 131 older adults (mean age = 75 years) assessed self-rated health and IL-6 every 6 months for up to 5 years. Multilevel models showed stable SRH (between-person differences), but not dynamic changes in SRH were associated with IL-6 (Arnberg et al., 2016). Similarly, in a study of 899 adults assessed at baseline, with 666 assessed 5 years later, worse SRH was significantly associated with higher hsCRP at baseline, independent of age, sex, BMI, and health behaviors. While higher baseline hsCRP was associated with poorer SRH at 5 year follow-up, this association did not remain after covariate adjustment (Tamura et al., 2018). Thus, SRH reflects current inflammation, but may not be a strong predictor of future inflammation which may indicate shared underlying correlates rather than a direct causal link. The current cross-sectional design did not permit for clarifying

temporal precedence, and future longitudinal data from the NCHAT cohort as well as other populations would be highly informative.

Another limitation of this study is lack of longitudinal data ultimately linking self-rated health with disease, disability, or mortality. Self-rated health is remarkably predictive of all-cause mortality, above and beyond traditional risk factors (Dramé et al., 2023). Meta-analyses suggest that this effect is consistent regardless of gender, age, or country of origin (DeSalvo et al., 2006). However, demographic differences in the predictive value of self-rated health for mortality have been noted in some studies, including in relation to age, gender, and socioeconomic status (Benyamini et al., 2003; Helweg-Larsen et al., 2003; Mackenbach et al., 2008). In addition, cohort effects have been reported whereby self-rated health is becoming more predictive over time, with evidence suggesting that this effect is driven by greater exposure to high quality health information (Schnittker & Bacak, 2014). Thus, there are multiple factors that contribute to an individual's self-rating of health including knowledge of one's health behaviors (Nehme et al., 2024), mood (Mulsant et al., 1997), fatigue/energy level (Engberg et al., 2017), as well as interoceptive cues, e.g., inflammatory processes and the relative weighting of various factors may differ based on gender, age, and other factors (Gupta et al., 2020; Hamplová et al., 2022; Jerdén et al., 2011; Spuling et al., 2015). Data are unavailable on the relative predictive value of self-rated health for mortality among LGBTQ+ compared to heterosexual adults. Future studies should include the assessment of sexual orientation to provide the opportunity to examine the effects of this important identity factor empirically.

The primary focus of this investigation was the link between inflammatory biology and self-rated health. While the overall finding of poorer SRH among sexual minority vs heterosexual adults was observed, we did not examine mediating and moderating effects related to differences in SRH by sexual orientation. As reviewed, prior studies suggest multifactorial pathways, and moderated mediation may also be present. Thus, adequately examining these questions was beyond the scope of the current analyses. However, the NCHAT parent study provides a wealth of information including but not limited to racial/ethnic identity, age, socioeconomic factors, mental health indicators, contextual level factors (e.g., state/local policy), internalized stigma, exposure to discrimination, health behaviors, and health conditions which could be leveraged to thoroughly interrogate this question.

The analysis plan in this investigation was not preregistered. As a result, the findings reported here should be considered exploratory and hypothesis-generating, warranting confirmation by future confirmatory studies. Further, the current analyses is a focus only on cisgender adults. Of note, in the full NCHAT parent study, approximately 4.5% of participants identify as nonbinary, transgender, or another non-cisgender identity. However, the number who provided biological samples for NCHAT-BIO was limited. Moreover, gender-affirming care affects inflammatory markers which are the focus herein, complicating inclusion (Schutte et al., 2022). Thus, future studies permitting for examination of biological correlates of self-rated health inclusive of non-cisgender individuals would strengthen the literature.

In sum, this study contributes novel and meaningful insights into self-rated health, inflammation, and LGBTQ+ identity. Our study strengthens the existing literature by leveraging NCHAT, a large population representative sample of partnered adults across the US, providing robust replication of prior findings that LGBTQ+ plus adults report poorer self-rated health than their heterosexual peers. Moreover, this study extends the literature by demonstrating that self-rated health is associated with inflammation, as indicated by both CRP and IL-6, with similar magnitude of effects regardless of gender and sexual orientation. Our findings underscore the value of including sexual orientation in health research. Given the powerful predictive validity of self-rated health for mortality and its demonstrated linked to inflammation, further investigation into how social and identity-related factors affect self-perceptions of health remains a priority for advancing health equity.

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Public Significance:

This study shows that a simple self-rated health question reflects underlying biological inflammation among both heterosexual and LGBQ+ adults. These findings highlight the value of including diverse sexual orientation identities in health research and demonstrate how subjective health assessments can provide meaningful insight into physical well-being and potential health disparities.

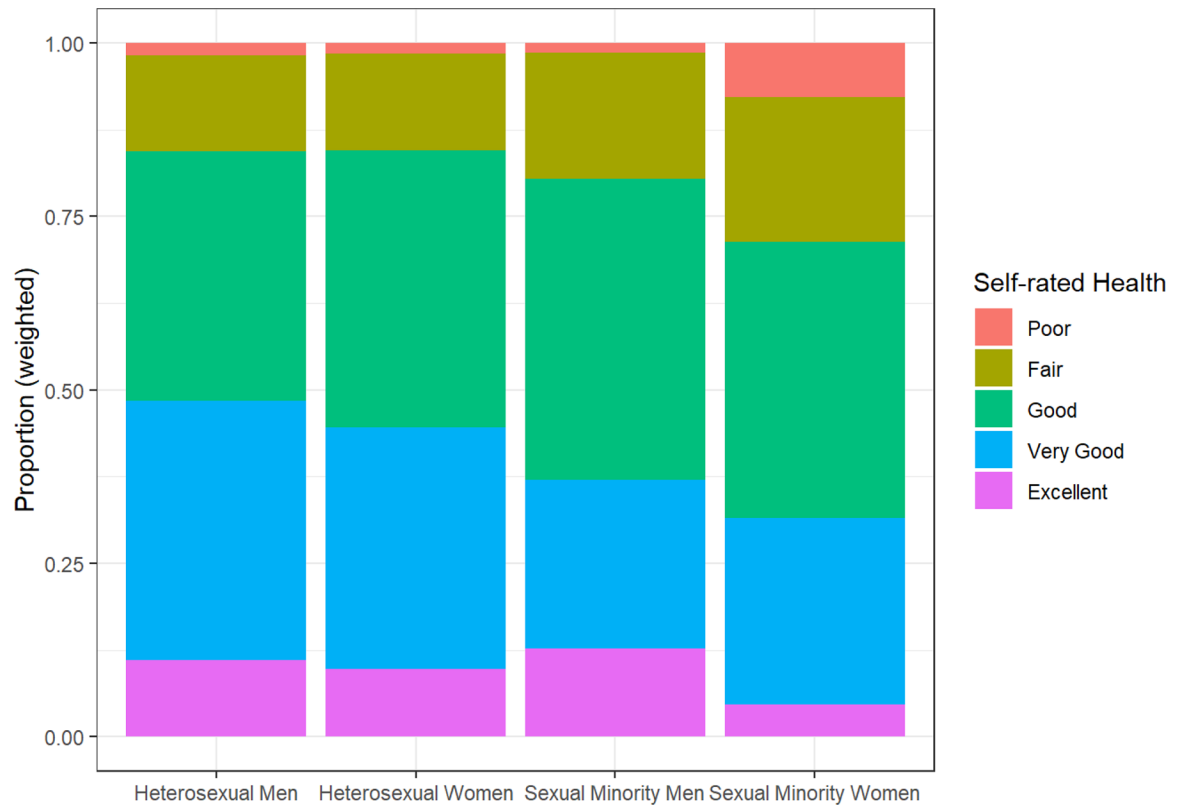


Fig 1. Self-Rated Health by Identity.

In the full NCHAT sample, self-rated health differed significantly based on sexual orientation, with poorer ratings among LGBTQ+ as compared to heterosexual adults after controlling for gender ($p < 0.001$).

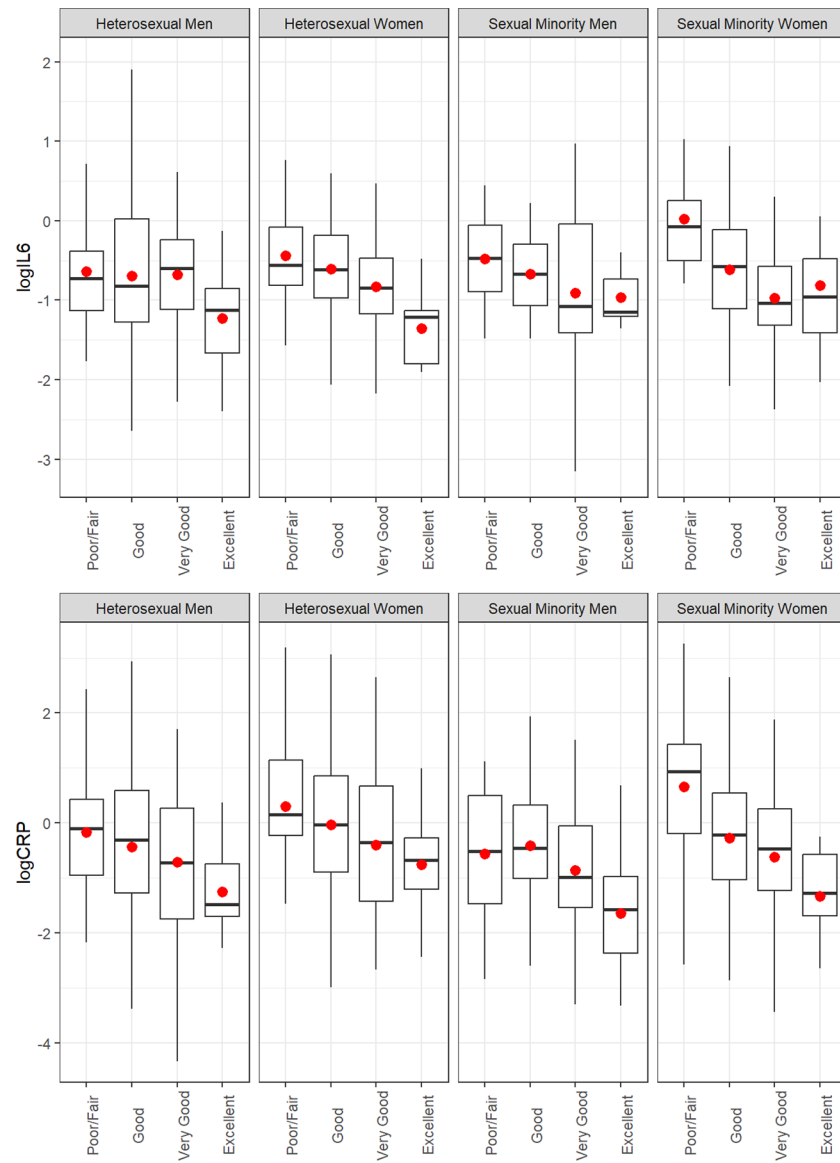


Fig 2a & 2b. Self-Rated Health and Inflammation.

Poorer self-rated health was associated with both higher IL-6 and CRP in the overall NCHAT-BIO subsample (p s < 0.001). The magnitude of this association was similar regardless of gender and sexual orientation.

Table 1.

Full-sample weighted demographic characteristics.

Characteristics	Overall (n = 3477)	Heterosexual Men (n = 1036)	Heterosexual Women (n = 960)	Sexual Minority Men (n = 723)	Sexual Minority Women (n = 758)	p-values ¹
Age (years)	43.03 (10.44)	43.64 (10.24)	43.00 (10.43)	39.41 (11.66)	35.32 (9.75)	<0.001
Body Mass Index (kg/m ²)	29.41 (6.88)	29.42 (6.22)	29.30 (7.35)	29.23 (7.59)	31.25 (8.70)	0.13
Number of health conditions	1.23 (1.67)	1.04 (1.56)	1.43 (1.75)	1.19 (1.78)	1.22 (1.59)	<0.001
Depressive symptoms	7.64 (5.98)	6.79 (5.40)	8.12 (6.22)	9.40 (6.35)	12.81 (7.13)	<0.001
Sleep quality	2.71 (0.94)	2.77 (0.93)	2.68 (0.95)	2.64 (0.79)	2.34 (0.88)	<0.001
Smoking						0.042
Current smoker	15.5 (518)	16.8 (166)	13.7 (131)	18.9 (109)	24.2 (112)	
Non-smoker	84.5 (2,951)	83.2 (869)	86.3 (825)	81.1 (611)	75.8 (646)	
Alcohol Use						<.0001
3: 1 + days per week	37.4 (1,502)	43.2 (441)	31.2 (314)	48.0 (406)	41.4 (341)	
2: 1–3 times per month	30.8 (1,004)	28.4 (302)	32.9 (308)	28.9 (170)	35.9 (224)	
1: non-drinker	31.8 (964)	28.4 (290)	35.9 (334)	23.1 (147)	22.8 (193)	
Self-Rated Health	3.38 (0.91)	3.42 (0.92)	3.37 (0.90)	3.29 (0.95)	3.00 (0.99)	<0.001

All presented statistics use the NCHAT survey weights except for ns which are unweighted.

¹Design-based Kruskal-Wallis rank sum test or Pearson's Chi-squared test with Rao-Scott correction

Table 2.

Demographic characteristics among participants with biological data

	Age	BMI	Health Conditions	Depressive Symptoms	Sleep Quality	IL-6 (ln)	CRP (ln)
Body Mass Index	0.04	--					
Health Conditions	0.39***	0.39***	--				
Depressive Symptoms	-0.18***	**	0.17***	--			
Sleep Quality	0.01	-0.15***	-0.22***	-0.50***	--		
IL-6 (ln)	0.05	0.45***	0.18***	0.11*	0.00	--	
CRP (ln)	0.01	0.56***	0.22***	0.11**	-0.10*	0.46***	--
Self-Rated Health	0.01	-0.42***	-0.36***	-0.34***	0.40***	-0.26***	-0.29***

*
p ≤ 0.05,
**
p ≤ 0.01,

p ≤ 0.001.

Table 3.

Pearson correlations among key variables in the NCHAT-BIO subsample

Characteristics	Overall (n = 652)	Heterosexual Men (n = 185)	Heterosexual Women (n = 198)	Sexual Minority Men (n = 98)	Sexual Minority Women (n = 171)	p-values [†]
Age (years)	43.16 (10.14)	44.66 (9.56)	43.85 (10.51)	43.16 (10.15)	40.73 (9.96)	0.002
Body Mass Index (kg/m ²)	29.82 (7.67)	29.89 (6.98)	29.55 (7.57)	28.53 (5.77)	30.78 (9.23)	0.10
Number of health conditions	1.33 (1.69)	1.15 (1.68)	1.62 (1.80)	1.02 (1.34)	1.37 (1.73)	0.006
Depressive symptoms	8.54 (6.06)	6.94 (5.05)	8.61 (6.44)	8.73 (6.03)	10.11 (6.25)	<0.001
Sleep quality	2.69 (0.93)	2.78 (0.88)	2.67 (0.99)	2.81 (0.94)	2.56 (0.89)	0.065
Smoking						0.41
Current smoker	15.2 (99)	17.8 (33)	15.7 (31)	10.3 (10)	14.6 (25)	
Non-smoker	84.8 (551)	82.2 (152)	84.3 (166)	89.7 (87)	85.4 (146)	
Alcohol Use						0.049
3: 1 + days per week	40.1 (261)	44.3 (82)	31.5 (62)	50.0 (49)	39.8 (68)	
2: 1–3 times per month	30.3 (197)	26.5 (49)	34.0 (67)	28.6 (28)	31.0 (53)	
1: non-drinker	29.6 (193)	29.2 (54)	34.5 (68)	21.4 (21)	29.2 (50)	
Self-Rated Health	3.35 (0.94)	3.36 (0.90)	3.38 (0.90)	3.44 (0.94)	3.27 (1.01)	0.54
IL-6	0.71 (0.84)	0.72 (0.87)	0.65 (0.62)	0.64 (0.54)	0.82 (1.11)	0.76
CRP	1.55 (2.79)	1.29 (2.31)	1.76 (2.92)	1.14 (2.72)	1.82 (3.09)	0.001

Mean (SD) or % (n)

[†]One-way ANOVA, Kruskal-Wallis rank sum test, and Pearson's Chi-squared test

Table 4.
Regression Model Examining Self-Rated Health and Inflammation in the NCHAT-BIO subsample

Effect	Model 1			Model 2			Model 3			Model 4		
	B	SE	p-value	B	SE	p-value	B	SE	p-value	B	SE	p-value
Intercept	-.62	.042	<.0001	-2.09	.23	<.0001	-2.18	.26	<.0001	-2.59	.31	<.0001
SRH	-.23	.042	<.0001	-.080	.046	0.08	-.076	.048	0.11	-.085	.049	0.081
BMI				.043	.005	<.0001	.043	.005	<.0001	.043	.005	<.0001
Age				.002	.004	0.61	.003	.004	0.43	.005	.004	0.28
Health Conditions				.006	.028	0.83	-.003	.028	0.93	.002	.028	0.95
Sex												
Male				(ref)			(ref)			(ref)		
Female				.043	.076	0.57	.043	.078	0.59	.039	.078	0.62
Depression score							.0039	.007	0.58	.012	.008	0.13
Alcohol Use												
1–3 times per month										.008	.099	0.94
1 or more days per week										-.14	.094	0.15
Non-Drinker										(ref)		
Smoking status												
Current smoker										.25	.10	0.01
Non-smoker										(ref)		
Sleep Quality										.12	.050	0.018
Effect	Model 1			Model 2			Model 3			Model 4		
	B	SE	p-value	B	SE	p-value	B	SE	p-value	B	SE	p-value
Intercept	-.27	.054	<.0001	-3.14	.297	<.0001	-3.25	.32	0.00	-3.34	.39	0.00
SRH	-.41	.054	<.0001	-.101	.055	0.067	-.094	.058	0.10	-.09	.06	0.14
BMI				.088	.006	<.0001	.088	.007	0.00	.089	.007	0.00
Age				-.002	.005	0.67	-.0001	.005	0.98	.0002	.005	0.96
Health Conditions				.017	.032	0.60	.011	.032	0.73	.005	.032	0.88
Sex												
Male				(ref)			(ref)			(ref)		
Female				.311	.092	0.0007	.32	.093	0.0005	.337	.094	0.0004
Depression score							.0034	.008	0.67	.003	.009	0.75

Alcohol Use				
1–3 times per month	.001	.12	0.99	
1 or more days per week	.021	.11	0.85	
Non-Drinker	(ref)			
Smoking status				
Current smoker	.27	.12	0.029	
Non-smoker	(ref)			
Sleep Quality	.008	.06	0.89	