PHYSICAL HEALTH IN LESBIAN-, GAY-, AND BISEXUAL-IDENTIFIED ADULTS

STATUS QUO AND UNDERLYING MECHANISMS FOCUSING ON MINORITY STRESS, PSYCHOLOGICAL FACTORS AND MENTAL HEALTH

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Danach befragt, wofür in ihren Augen der Begriff ‚Rassismus' steht, antwortet die amerikanische Intellektuelle Ruth Gilmore, er bedeute für bestimmte Teile der Bevölkerung das Risiko eines verfrühten Todes.

Diese Definition gilt ebenso für männliche Vorherrschaft, für Homophobie, Transphobie, Herrschaft einer Klasse über eine andere, für alle Phänomene sozialer oder politischer Unterdrückung.

Édouard Louis in *Wer hat meinen Vater umgebracht?*

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ABSTRACT

Background and Objectives: Regarding mental health, many studies and systematic reviews have consistently indicated mental health disparities to the detriment of sexual minority individuals compared to heterosexual individuals. With regard to the status quo of physical health, however, empirical evidence lags behind, and systematic reviews are still sparse (for women) to non-existent (for men). Therefore, the first objective of this thesis was to answer Research Question I: What is the status quo of physical health among sexual minority individuals? Specifically, does the prevalence of physical health conditions differ between lesbian- and bisexual-identified women compared to heterosexual-identified women, and gay- and bisexual-identified men compared to heterosexual-identified men? When examining causes for both mental and physical health disparities, 'minority stress' is often discussed. In a theoretical framework, Lick et al. (2013) proposed that minority stress influences health outcomes, mediated by psychological stress responses and other factors. Since some of the pathways postulated by Lick et al. (2013) have not yet been tested, the second objective was to provide empirical evidence to answer Research Question II: Is there a negative total effect of intersectional minority stress on the physical health of lesbian-, gay-, and bisexual-identified individuals? Is the effect mediated by mediated by psychopathological stress responses, resilience, and health literacy?

Methods: Research Question I was addressed in Studies I and II within the framework of a comprehensive systematic review and meta-analyses on physical health conditions in lesbian- and bisexual-identified women compared to heterosexual-identified women (Study I), and in gay- and bisexual-identified men compared to heterosexual-identified men (Study II). A systematic literature search was conducted across six databases for epidemiologic studies, published between 2000 and 2021, on physical health conditions that fit into the classification of the Global Burden of Disease project (Institute for Health Metrics and Evaluation, 2020). Meta-analyses on odds ratios were performed. In total, 44 studies were included in the women's review, and 32 studies were included in the men's review. Research Question II was addressed in Study III, a cross-sectional online-survey in a final sample of 521 German lesbian-, gay-, and bisexual-identified adults aged (≥18 years). For mediation analysis, Structural Equation Modelling (SEM) in AMOS V.29 was applied.

Results: Regarding Research Question I, the main results were: (i) For both women and men, the most notable differences in prevalence by sexual identity were observed in chronic respiratory conditions, particularly asthma, with a higher prevalence in sexual minority individuals. (ii) Beyond chronic respiratory conditions, a higher prevalence in sexual minority individuals was found regarding a number of further health conditions, e.g., headache disorders and back pain. (iii) A lower prevalence was found regarding pregnancy-related conditions and cancer in sexual minority women. No lower prevalence was found in sexual minority men. (iv) Furthermore, two trends could be observed: regarding some of the stress-related conditions, 1) bisexual-identified individuals tended to be more affected than lesbian- and gay-identified individuals, and 2) women tended to be more affected than men. Regarding Research Question II, the main results were: (v) There was a negative total effect of intersectional minority stress on the physical health of lesbian-, gay-, and bisexual-identified individuals. (vi) This total effect of intersectional minority stress on physical health was primarily mediated by psychopathological stress responses, which were mitigated by resilience. Health literacy did not contribute to the mediation.

Conclusion: We found evidence of physical health disparities to the detriment of both lesbian- and bisexual-identified women, as well as gay- and bisexual-identified men, compared to heterosexual-identified individuals. Furthermore, we gained insights into mechanisms that contribute to these health disparities: intersectional minority stress was found to have a negative total effect on physical health, mediated mainly by psychopathological stress responses that were buffered by resilience. Future studies should validate these findings using longitudinal designs. It should also be of future research interest to develop and evaluate interventions to reduce minority stress and strengthen resilience in sexual minority individuals. From a practical perspective, healthcare professionals should develop greater awareness of physical conditions with existing disparities, as well as the potential impact of minority stress on physical health.

STUDIES INCLUDED IN THE CUMULATIVE THESIS

The cumulative thesis comprises three key contributions, referred to as Study I, Study II and Study III. Study I and Study II were part of the same project, a comprehensive systematic review and meta-analyses, with one Study focusing on women (Study I), and the other on men (Study II).

STUDY I

Haarmann, L., Folkerts, A.K., Lieker, E., Eichert, K., Neidlinger, M., Monsef, I., … & Kalbe, E. (2023). Comprehensive systematic review and meta-analysis on physical health conditons in lesbian- and bisexual-identified women compared to heterosexual-identified women. *Women's health, 19*, 1-27. https://doi.org/10.1177/17455057231219610

STUDY II

Haarmann, L., Lieker, E., Folkerts, A.K., Eichert, K., Neidlinger, M., Monsef, I., … & Kalbe, E. (2024). Higher risk of many physical health conditions in sexual minority men: Comprehensive systematic review and meta-analysis in gay- and bisexual-identified compared with heterosexual-identified men. *LGBT health, 11*(2), 81-102. https://doi.org/10.1089/lgbt.2023.0084

STUDY III

Haarmann, L., Dennert, G., Folkerts, A.K., Träuble, B., Kalbe, E. (submitted). Key Role of Psychopathological Stress Responses in explaining how Intersectional Minority Stress affects Physical Health: Results from a German cross-sectional Online-Survey in Lesbian-, Gay- and Bisexual-identified Individuals. *(Note: Study III is submitted and therefore included as a manuscript.)*

RELATED PUBLICATION

Wortmann, L., **Haarmann, L.,** Yeboah, A., & Kalbe, E. (2023). Data from: Gender medicine teaching increases medical students' gender awareness: results of a quantitative survey. *GMS Journal for Medical Education, 40*(4). http://doi: 10.3205/zma001627

SCIENTIFIC CONTRIBUTIONS

For detailed information on the authors' contributions to the individual parts of the studies, please refer to the scientific contribution statements at the beginning of the summaries of Study I, Study II, and Study III, respectively. (*Note:* Study I and Study II were part of the same project.)

LIST OF ABBREVIATIONS

AGFI	Adjusted Goodness of Fit Index
AIDS	Acquired Immunodeficiency Syndrome
AOR	Adjusted Odds Ratio
Bi	Bisexual-Identified
BIPoC	Black, Indigenous and People of Colour
BRFSS	Behavioral Risk Factor Surveillance System
CASP	Critical Appraisal Skills Programme
CFI	Comparative Fit Index
CHIS	California Health Interview Survey
CI	Confidence Interval
COPD	Chronic Obstructive Pulmonary Disease
COVID-19	Coronavirus Disease 2019
CSD	Christopher Street Day
CVD	Cardiovascular Disease
GBD	Global Burden of Disease (Project)
HIV	Human Immunodeficiency Virus
HL	Health Literacy
ICD	International Classification of Diseases
IFI	Incremental Fit Index
IHME	Institute for Health Metrics and Evaluation
ILGA World	International Lesbian, Gay, Bisexual, Trans, and Intersex Association
Les	Lesbian-Identified
LGBTIQA*	Lesbian, Gay, Bisexual, Trans*, Inter*, Queer, Asexual
MS	Minority Stress
NHIS	National Health Interview Survey
OR	Odds Ratio
PH	Physical Health
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analyses
PROSPERO	International Prospective Register of Systematic Reviews
PSR	Psychopathological Stress Responses
R	Resilience
RMSEA	Root Mean Square Error of Approximation
SD	Standard Deviation
SDGs	Sustainable Development Goals of the United Nations
SEM	Structural Equation Model(ing)
SMM	Sexual Minority Men
SMSR	Standardized Root Mean Square Residual

SMW	Sexual Minority Women
STDs	Sexually Transmitted Diseases
UK	United Kingdom
UN	United Nation
USA	United States of America
WHO	World Health Organization
WSW	Women who have Sex with Women

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POSITIONING – DISCLAIMER

Positioning: This thesis focuses on sensitive topics such as health disparities, discrimination and potential resulting health disadvantages. Throughout the phases of this work, it has become evident that these topics evoke strong emotional responses in society. This is likely because these topics indirectly challenge prevailing heteronormative power structures and perspectives. As we all navigate structures shaped by different axes of power, we are inevitably involved in exercising power and are constantly affected by it, either actively, or passively, or both. This also applies to science. Therefore, it seems important to me to briefly describe my own position regarding the dimensions relevant for this thesis. In doing so, I follow Emilia Roig, who discusses scholars' self-positioning in her book *Why We Matter* (Roig, 2021). She quotes the American professor Donna Haraway, who coined the term 'Situated Knowledge' in 1988, stating: "By acknowledging and understanding the relevance of their own position in the world, and thus the influenceability of their claims to knowledge, researchers are more authentic and truthful than if they claim to be neutral observers" (Roig, 2021, p. 128).

I identify as a cisgender lesbian woman. This identity grants me certain privileges, as my gender identity aligns with the sex[1] assigned to me at birth. Simultaneously, I recognize that we live in a society where male dominance persists, leading to ongoing disadvantages for women, as well as all other genders, in comparison to cisgender men. Being a lesbian woman and growing up in a rainbow family, from an early age on, I have experienced some of the challenges that queer people and queer families face in heteronormative societies. However, I have had the privilege of growing up in what felt to me like a predominantly queer-friendly environment. I also identify as a *white* woman. I recognize my *white* European-influenced perspective, and I acknowledge that my understanding of the world is shaped by this cultural and societal position. I recognize

[1] According to Ainsworth (2015), 'sex' refers to the biological attributes of an individual, including their anatomy, chromosomes, and hormones. This encompasses physical characteristics typically categorized as male or female, though there are many variations beyond this binary classification. 'Gender' pertains to the roles, behaviours, activities, and societal expectations that a given culture typically considers appropriate for men and women. Gender identity is how individuals perceive and refer to themselves, which can be different from their sex and can go beyond the binary understanding of female and male (Butler, 2002; Ainsworth, 2015).

the privileges associated with my ethnic identity and strive to incorporate this reflection into my work. Regarding formal education, I have had the privilege of growing up in a family that strongly encouraged academic pursuits. Both of my parents studied at universities, which provided me with the privilege of feeling that the opportunity to study was undisputed and accessible to me.

Disclaiming note: In many of the studies reported in this thesis, sex and gender are frequently depicted in binary terms. This binary depiction does not reflect the actual diversity observed both biologically (sex) and socially (gender), failing to capture the full spectrum present in society (Ainsworth, 2015; Bartig et al., 2021; Butler, 2002). Despite this, there is a notable lack of studies that move beyond this binary framework. Consequently, the analyses within the two systematic reviews are limited to referencing studies that predominantly adhere to a binary understanding of sex and gender.

PREFACE

This thesis primarily focuses on potential physical health disparities in sexual minority individuals compared to the majority of heterosexual individuals. Another focus is on experiences of discrimination, minority stress, and possible consequences for the health of individuals belonging to sexual minorities. Potential factors influencing physical health disparities and experiences of discrimination do not occur in a vacuum but are embedded within the respective societal context that shapes the experiences of queer individuals. The societal landscape surrounding queer life is both culturally dependent and dynamically evolving. During the development of this work, the following events[2] have occurred: At first, I would like to highlight some advancements: Internationally, a positive development is that during the timeframe of this thesis, marriage for same-sex couples was legalized in the following countries and years: Chile and Switzerland in 2021; Cuba and Mexico in 2022; Andorra, Estonia, and Slovenia in 2023; and Greece and Thailand in 2024 (LSVD, 2024a). Regarding positive developments in Germany, the Self-Determination Act was introduced to simplify the process for trans*, inter*, and non-binary individuals to change their gender entry and names. The German government presented a corresponding bill on August 23, 2023, which was passed by the German Bundestag on April 12, 2024 (Bundesministerium für Familie, 2024). Starting November 1, 2024, the Self-Determination Act will enable individuals to change their gender entry in the civil registry and their names through a declaration to the registry office, eliminating the need for a court decision or expert opinions (Bundesministerium für Familie, 2024). While this new Self-Determination Act, in many ways, marks an improvement over previous regulations, it has also faced criticism for unnecessary hurdles such as the three-month notice period (requirement to notify changes in advance) and a one-year waiting period (mandatory delay before further changes can be made) (taz, 2023).

During the timeframe of this thesis, the following events occurred as well: In December 2020, the International Lesbian, Gay, Bisexual, Trans, and Intersex Association (ILGA World) released a world map depicting the legal landscape concerning sexual orientation, revealing that same-sex sexual activities are still criminally prosecuted in approximately one-third of all

[2] Note: The reported events are exemplary and meant to provide some focal points as a rough overview, and are by no means exhaustive or comprehensive.

UN member states, with seven countries imposing the death penalty for homosexuality (Kalajdzisalihovic Vuga et al., 2022). In the data collection published by the ILGA in 2023, which provides detailed information on the legal situation in individual countries, six countries still upheld the death penalty (e.g., Iran, Nigeria, and Saudi Arabia) (LSVD, 2024b). Furthermore, in six other countries, the death penalty could be imposed under certain conditions against homosexuals (e.g., Afghanistan or Qatar) (LSVD, 2024b). In Iran, Cameroon, and Uganda (among others), individuals identifying as LGBTIQ+ are arrested based on their actual or perceived sexual orientation and gender identity (Kalajdzisalihovic Vuga et al., 2022). For instance, in August 2022, the two Iranian LGBTIQ+ activists, Zahra Sedighi-Hamadani and Elham Choubdar, were sentenced to death for "spreading corruption on earth" after peacefully advocating for LGBTIQ-communities on social media. The reasons for their conviction were their actual or perceived sexual orientation and/or gender identity. At the urging of international aid organizations, the death sentences were overturned in January 2023 (Amnesty International, 2023).

In a study published in 2020 based on a survey conducted by the US-based Pew Research Centre, 38,426 individuals from 34 countries were asked whether they believed homosexuality should be accepted by society. Results showed large international differences, with acceptance ranging from 92% in the Netherlands to single-digit figures in Nigeria (7%), Tunisia (9%), and Indonesia (9%). Overall, in Western Europe and America, acceptance rates were higher as compared to acceptance rates in Eastern Europe, Russia, the Middle East, and Sub-Saharan Africa (LSVD, 2024b).

Uganda, as an example of a Sub-Saharan African country, has recently further intensified penalties against homosexuality: In March 2023, Uganda's Parliament approved the death penalty in certain cases under the Anti-Homosexuality Act 2023 (Human Rights Watch, 2024). This includes scenarios like sexual assault, rape, and acts involving minors, elderly, or disabled individuals, but also convictions for repeated consensual homosexual activity. Life imprisonment for attempted offenses was also specified. The law drew international condemnation from the USA, the EU, and human rights groups but was signed by President

Yoweri Museveni on May 29, 2023. Despite challenges from activists and lawmakers, Uganda's Constitutional Court upheld the law on April 3, 2024 (Human Rights Watch, 2024).

Today, many African countries have some of the harshest penalties and most challenging situations for queer individuals (LSVD, 2024b). However, one often overlooked fact that must be consistently acknowledged is that homophobia in Africa stems from an imported issue, as highlighted by Ugandan queer activist Ssenfuka Joanita Warry in an interview with the Heinrich Böll Foundation in December 2020. During that interview, Ssenfuka Joanita Warry stated: "There are a lot of misconceptions about homosexuality in Uganda and East Africa. There is this notion that homosexuality is 'un-African,' but in reality, it is very African. What has been imported is homophobia. When the Christian missionaries came to the country, they found people who loved each other and created a law prohibiting love between people of the same sex. Therefore, homophobia is un-African, but homosexuality is African" (Simons, 2020).

While, on average, queer individuals in countries from the Global North[3] (Pagel et al., 2014; Petnguen & Amoussou, 2023) face fewer obstacles and less criminalization, significant challenges, barriers, and difficulties persist, and developments are by no means unidirectionally positive in these countries: For instance, in 2023, a record number of at least 510 anti-LGBTIQ bills were introduced in state legislatures across the United States, as reported by the American Civil Liberties Union (Choi, 2024). This marked a significant increase compared to 2022, nearly

[3] The term 'Global North' refers to a group of wealthy countries primarily situated in the Northern Hemisphere, typically known for stable economies, advanced technological infrastructure, and high standards of living (Pagel et al., 2014). However, this group also includes countries like Australia and New Zealand, despite being located in the Southern Hemisphere, so the definition is understood to be independent of geographic location (Petnguen & Amoussou, 2023). The countries from the 'Global North' remain in a privileged position compared to countries from the 'Global South' due to the enduring structures of oppression and exploitation that originated in the European colonial era (Petnguen & Amoussou, 2023). Unlike the Eurocentric term 'Western countries', 'Global North' focuses on economic and structural differences, highlighting global inequalities and the responsibility of wealthy nations in global issues. However, the terms 'Global North' and 'Global South' have also been subject to criticism for oversimplifying complex global dynamics and perpetuating historical inequalities, particularly from a postcolonial perspective. Therefore, when using these terms, these critiques and differentiations should be mentioned and considered (Pagel et al., 2014; Petnguen & Amoussou, 2023).

tripling the number of bills introduced. Notably, education and health-care related bills surged, with a particular emphasis on regulating curriculum in public schools and restricting access to gender-affirming healthcare for trans* youth (Choi, 2024). Furthermore, in their 2022 annual crime report, the FBI documented a significant increase in anti-LGBTIQ+ hate crimes, with a 13.8% rise in crimes based on sexual orientation and a staggering 32.9% increase in crimes based on gender identity. Overall, more than one in five hate crimes in the USA targeted LGBTIQ+ individuals in 2022 (Luneau, 2023).

In Europe, there are also developments worsening the situation for queer individuals: On June 15, 2021, the Hungarian Parliament, with votes from the ruling party Fidesz under Viktor Orbán and the far-right party Jobbik, passed a 'child protection law' banning the depiction of homosexuality to minors, so-called 'gay propaganda.' This encompasses educational campaigns for students or depictions of homosexuality in advertising or media for children, such as books and films (European Parliament, 2021). In Russia, at least partially considered part of Europe, similar developments were observed at the end of November 2023: Russia's Supreme Court labeled the LGBTIQ+ community as 'extremist', imposing a nationwide ban on their activities (tagesschau, 2023). This broad ruling, criticized by human rights groups, significantly restricts the rights of queer individuals. The practical implications of the ban are uncertain, but it is anticipated to severely hinder LGBTIQ+-related organizations and activists, potentially further suppressing public discourse on LGBTIQ+ issues (tagesschau, 2023). Moreover, there have been further hate crimes in Europe that victimized queer people. On June 25, 2022, two people were killed in front of Norway's biggest LGBT club, 'London Pub' in Oslo (Audureau, 2022). On October 12, 2022, Juraj Vankulic (27) and Matus Horwath (23) were shot standing outside in front of the well-known homosexual meeting spot 'Café Teplaren' in Bratislava, Slovenia (Otajovicova, 2023). A sad and prominent example of hate violence in Germany is the killing of trans* man Malte C. (25) during Christopher Street Day (CSD) in Münster on August 27, 2022. A 20-year-old man insulted several participants during the CSD (Deutsche Welle, 2022). When Malte C. tried to intervene, the attacker hit him in the chest and repeatedly on the head. Malte C. fell on the pavement and died several days later from the consequences of a traumatic brain injury (Deutsche Welle, 2022).

This incomplete list exemplifies some of the barriers and difficulties faced by queer people and their experiences in heteronormative societies. As both a social scientist and a psychologist, I have always been particularly interested in how social and societal phenomena, and intrapersonal processes interact to influence the well-being and health of individuals. My own queer perspective has deepened my interest in the health of this community in particular. Before I started the work on this thesis, I had heard of the relatively well-researched mental health disparities in sexual minority individuals compared to the majority of heterosexual individuals. From a holistic perspective of viewing mental and physical health as interconnected rather than distinct entities, I started to get interested in whether there are physical health disparities in sexual minorities compared to heterosexual individuals as well. I also got more and more drawn to the question whether discrimination could be one factor to explain some of the (potential) health disparities regarding both mental and physical health. Exploring these topics scientifically became the main objectives of this thesis, encapsulated in the questions:

Are there physical health disparities in sexual minority individuals compared to heterosexual individuals? Do experiences of discrimination or the fear thereof affect queer peoples' health?

CHAPTER 1 – INTRODUCTION

The structure of the thesis is as follows: In the introduction (Chapter 1), the central concepts of the work are introduced, along with an overview of the current state of research on their interconnections. Against this background, Chapter 2 presents the objectives, research questions, and hypotheses of the present thesis project. Next, the three contributions of the cumulative dissertation are summarized: Firstly, Studies I and II on the systematic reviews and meta-analyses on physical health conditions in lesbian, gay, and bisexual compared to heterosexual individuals are described (Chapter 3). This is followed by the summary of Study III, the online-survey on minority stress and health in lesbian, gay, and bisexual individuals (Chapter 4). The final chapter (Chapter 5) provides a discussion of the main findings of the thesis. Furthermore, the chapter explores general strengths and limitations, and considers implications for future research and practice. The general conclusion summarizes the overall findings.

1.1. SEXUAL MINORITY INDIVIDUALS: DEFINITION

Empirical research on 'sexual minority individuals' necessitates careful consideration of terminologies, as there is a lack of universally accepted definitions and delineations (Moradi et al., 2009). This applies to both the overarching term 'sexual minority individuals' and the subgroups that are typically grouped under the umbrella term 'sexual minority individuals' such as lesbian, gay, bisexual, etc. (Moradi et al., 2009). From an individual perspective, this absence of universally accepted definitions is inherently beneficial and appropriate, as externally imposed definitions restrict one's self-autonomy of defining their sexual orientation freely (Dreßen, 2021). However, from a scientific perspective, especially in empirical research, this presents a challenge, as clear categorizations and delineations are essential for meaningful analysis and interpretation (Cerwenka & Brunner, 2018). Hence, it is important for scientific research to establish working definitions that provide common ground for the specific research inquiry (Moradi et al., 2009). Yet, it is equally important to acknowledge that these definitions

constitute partly artificial categorizations that do not always feel completely congruent with how an individual identifies (Cerwenka & Brunner, 2018).

In order to establish working definitions, some crucial factors have to be considered, that are referred to in the literature when attempting to define sexual minority individuals (Moradi et al., 2009). One such factor is whether sexual minority individuals should be defined and studied as a whole group or as subgroups. While including the entire group risks oversimplification and information loss, focusing solely on a specific subgroup may lead to overly selective representation (Moradi et al., 2009). Researchers argue that the principle of inclusion often aims to rectify the scientific neglect of specific subgroups by emphasizing shared experiences. However, this approach can lead to misinformation, as it may overlook the unique experiences of individual subgroups (Moradi et al., 2009). Scientists must therefore balance between 'inclusion' and 'distinctiveness', considering the advantages and disadvantages of 'generalization' versus 'selectivity' with regard to the specific research questions (Moradi et al., 2009).

Another crucial factor concerns the appropriate dimension used to define sexual minority individuals. In everyday language, 'sexual orientation' is the most commonly used term, and 'sexual orientation' is often times perceived as a singular dimension crucial for defining sexual minority individuals (Dembroff, 2016). However, from a scientific perspective there is some common sense that 'sexual orientation' encompasses three dimensions that often overlap, but can also differ (Bailey et al., 2016; Wittgens et al., 2022). According to the American Psychology Association (American Psychology Association, 2015), sexual orientation includes "a person's sexual and emotional *attraction* to another person and the *behaviour* and/or *social affiliation* that may result from this attraction" (American Psychology Association, 2015, p.862). These three dimensions share the common aspect of one's sexuality being perceived in relation to the gender of another person, thus being *oriented* towards the other individual, hence the term 'sexual orientation' (Dembroff, 2016). In research literature, the three dimensions are most commonly referred to as *sexual attraction*, *sexual behaviour* and *sexual identity* and can be described as follows (Geary et al., 2018):

Sexual attraction refers to the emotional, romantic or physical attraction that an individual may feel towards another person. It involves desires, fantasies, and feelings of arousal towards another person (Bailey et al., 2016).

Sexual behaviour refers to the actions or activities that individuals engage in as part of their sexual interactions with others. It includes a wide range of behaviours such as kissing, touching, intercourse, and other forms of sexual activity (Bailey et al., 2016).

Sexual identity encompasses an individual's self-conception and refers to how they perceive and label themselves in terms of their sexual preference towards others. Sexual identity is understood as an integral aspect of one's identity (Bailey et al., 2016).

People whose sexual orientation deviates from the common heterosexual norm (women oriented towards men, men oriented towards women) in at least one of these three dimensions (attraction, behaviour, identity) are often grouped under acronyms, such as LGB (Lesbian, Gay, Bisexual). The following definitions for the subgroups classified under this acronym are sourced from an article within the German Federal Health Reporting by the Robert Koch Institute and Destatis, which focuses on the health status of sexual minority individuals (Pöge et al., 2020):

Lesbian woman: A person who identifies as a woman and loves other women emotionally, romantically, and/or physically (Pöge et al., 2020).

Gay man: A person who identifies as a man and loves other men emotionally, romantically, and/or physically (Pöge et al., 2020).

Bisexual individual: A person who loves both women and men or more than one gender emotionally, romantically, and/or physically (Pöge et al., 2020).

As previously mentioned, the dimensions of sexual orientation often overlap but can vary from person to person. While someone may identify as heterosexual, they may have had same-sex attractions and/or engaged in same-sex behaviours at some point in their lives (Bailey et al., 2016). Similarly, someone may identify as gay or lesbian, but may have engaged in heterosexual behaviours and/or had opposite-sex attraction before (Bailey et al., 2016). In a stricter sense, 'lesbian women' or 'gay men' primarily denote *sexual identity,* whereas in terms of *sexual behaviour*, for example, it is often referred to as 'women who have sex with women' (WSW),

or in terms of *attraction*, 'women attracted to women' for example. However, since there are no universally agreed-upon definitions, this distinction is not always clear-cut in every context, and sometimes the term 'lesbian women' is used in a sense that includes WSW or women attracted to women as well (Bailey et al., 2016).

In addition to LGB, it is rather common to use longer acronyms like LGBTIQ (including additional letters for Trans*, Inter*, and Queer individuals) in the context of sexual minority individuals. They can be described as follows (Dreßen, 2021):

Trans* individual: Individual who does not fully, barely, or not at all identify with their sex assigned at birth. Some, but not all, people who identify as trans* seek physical changes in order to align their sex assigned at birth with their gender identity. Trans* individuals are sometimes also referred to as 'non-cisgender'. In contrast, 'cisgender' is the term for individuals who feel in line with their sex assigned at birth. (Dreßen, 2021).

Inter* individuals: A person whose sex cannot be assigned to the binary medical definition of male and female. Inter* individuals are born with genetic, anatomical, and/or hormonal variations of sex characteristics (Dreßen, 2021).

Queer individual: Often used as an umbrella-term for all individuals who do not identify as heterosexual or with the binary gender categories of male or female (Dreßen, 2021).

In literature, these last mentioned, particularly trans* and inter* individuals, are more commonly classified as 'gender minority individuals' rather than 'sexual minority individuals' (Fredriksen-Goldsen et al., 2014). It is important to emphasize that these terms, though closely related, are not equivalent (Fredriksen-Goldsen et al., 2014). Sexual minorities are considered as such because the *gender of the desired partner* does not align with societal expectations, whereas gender minorities are individuals whose *own gender* or gender identity does not conform to societal norms or expectations (Dreßen, 2021; Fredriksen-Goldsen et al., 2014).

The acronym LGBTIQA* that is used as well includes the 'A' for 'asexual', described as (Dreßen, 2021):

Asexual individual: Asexuality is a sexual orientation characterized by little to no sexual attraction towards others, yet it doesn't imply a lack of emotional or romantic connections.

Furthermore, the asterisk (*) symbolically represents the diversity of sexual and gender minorities and other terms associated with the word queer, such as pansexual, genderqueer, or agender (Dreßen, 2021).

Focus on lesbian-, gay-, and bisexual-identified Individuals: Rationale and Scope

After establishing working definitions, regarding the present thesis, it is crucial to specify which individuals should be targeted in this thesis and why: The focus of this thesis is on lesbian, gay, and bisexual persons. The selection of the LGB subgroup is primarily because the theorized models underlying this thesis were postulated for LGB individuals (Lick et al., 2013; Meyer, 2003). Regarding the aforementioned discussion on 'inclusion' and 'distinctiveness,' the unifying element of the three subgroups (LGB) is emotional, romantic, and/or physical same-sex love. Additionally, existing research literature, particularly the large national and regional representative health studies used for the reviews (Study I and II), predominantly concentrate on LGB populations. Hence, at this point in time, meaningful comparisons in terms of reasonable statistical summaries could most sensibly be made for this subgroup. However, I hope that future large representative studies will include more subgroups as there is the need to provide data for all sexual and gender minority subgroups.

Furthermore, this thesis considers different dimensions of sexual orientation (attraction/behaviour/identity) as distinct units of analysis. Therefore, to maximize precision, this thesis focuses on one of them, i.e., identity. The rationale for choosing sexual *identity* over the other two is that previous research has found that sexual identity (vs. attraction and behaviour) was the measure perceived to be most relevant in the context of minority stress (Geary et al., 2018). Since large parts of this thesis are grounded in the theory of minority stress and its impact on health, identity was considered the most suitable choice for integrating theoretical models and prior research into the current research question.

To sum up, this thesis, both the systematic reviews of Study I and II as well as the online-survey (Study III), focus on lesbian-, gay-, and bisexual-identified individuals. Therefore, the

following sections on what is known about health among sexual minority individuals primarily focus on this subgroup (LGB), unless stated otherwise.

1.2. HEALTH IN LESBIAN, GAY, AND BISEXUAL INDIVIDUALS

For a long time, research on the health of sexual minority individuals has predominantly focused on sexually transmitted diseases (STDs), particularly the human immunodeficiency virus (HIV) in gay men (Lick et al., 2013). However, also due to institutional efforts addressed further below, there has been a shift that has primarily focused on the mental health and, subsequently (albeit with some delay), on non-HIV related general physical health of sexual minority individuals. The next section aims to provide an overview of the results of these research efforts, particularly those of the current century. In preparation for the main questions of this thesis, the focus is primarily on studies that examine the prevalence rates of lesbian, gay and bisexual individuals compared to those of heterosexual individuals.

1.2.1. Mental Health

The World Health Organization (WHO) defines mental health as "a state of mental well-being that enables people to cope with the stresses of life, realize their abilities, learn well and work well, and contribute to their community," indicating that "mental health is more than the absence of mental disorders" (World Health Organization, 2024c). Therefore, 'mental health' encompasses various aspects that could be addressed, when comparing the mental health status of sexual minority and heterosexual individuals. However, in preparation for the conducted study, the focus regarding mental health primarily revolves around Axis-I disorders, particularly the most common ones, like depression and anxiety disorders, along with associated issues such as suicidality.

With regard to depression, results from a large sample of the Health Minds Study among college students showed that, on average, students from all gender and sexual minority subgroups had higher rates of major depressive disorder than heterosexual students (Borgogna et al., 2019). Disparities were larger for bisexual compared to heterosexual individuals than for

lesbian/gay compared to heterosexual individuals (Borgogna et al., 2019). The same pattern was found in a sample of high school students in New Zealand (Denny et al., 2016). Also, in a more recent study in a large sample of more than 40,000 young adults (≥18 years), more than one fifth of the lesbian or gay participants and nearly one third of the bisexual participants have suffered from depression, compared to only slightly over 10% of the heterosexual participants (Horwitz et al., 2020).

Similar results were found with regard to anxiety disorders: In the aforementioned large sample of college students from the Health Minds Study, lesbian/gay students were more than 50% more likely, and bisexual individuals were even between three and four times more likely, to suffer from generalized anxiety disorder than heterosexual college students (Borgogna et al., 2019). In another large sample of more than 8,000 young Australian females (25–30 years old), the risk for anxiety disorders was found to be about three times higher in lesbian women and over four times higher in bisexual compared to heterosexual women (McNair et al., 2011).

Furthermore, there are hints that sexual minority persons have a higher risk of substance use disorders, such as hazardous drinking, than heterosexual persons. For example, in a large sample of the adult population (16+ years) in the United Kingdom, the prevalence of alcohol use was about 1.5–2 times higher in lesbian, gay and bisexual adults (Shahab et al., 2017). Similarly, in a global sample of young adults (16–35 years), alcohol use was 10–70% higher in lesbian, gay and bisexual compared to heterosexual young adults (Demant et al., 2017).

With regard to suicidality, the adjusted odds ratios for reporting two or more suicide risk factors (depression, heavy alcohol use, suicide ideation, suicide attempt) were shown to be significantly elevated for all sexual minority subgroups compared to heterosexual individuals (Horwitz et al., 2020). Persistent concerns regarding suicidality among sexual minority individuals, particularly in comparison to heterosexual individuals, are underscored by the findings of the following study: Over the course of a 15-year longitudinal study in Canadian youth, it was noted that suicide rates have seen a decline among heterosexual adolescents while remaining unchanged among sexual minority adolescents (Peter et al., 2017).

Since the beginning of this century, there has been an increasing number of efforts to systematically aggregate the findings of individual studies on the mental health of sexual minority individuals compared to heterosexual individuals. An early systematic review on mental disorders, suicide, and self-harm summarized findings from studies between 1966 and 2005, indicating a twofold increased rate of suicide attempts in LGB compared to heterosexual adults (King et al., 2008). Additionally, the risk of depression, anxiety disorders, and substance dependence was at least 1.5 times higher compared to heterosexual individuals (King et al., 2008). A comprehensive search for another systematic review identified 199 relevant studies, which collectively indicated elevated risks for depression, anxiety, suicide attempts or completions, and substance-related problems among sexual minority individuals compared to heterosexual individuals (Plöderl & Tremblay, 2015). These risks persisted across diverse geographic regions and dimensions of sexual orientation, such as attraction, behaviour and identity. Bisexual individuals were found to consistently exhibit the highest risk across most studies (Plöderl & Tremblay, 2015). A meta-analysis including 12 studies from the United Kingdom on mental health and well-being revealed that, after adjusting for covariates, adults identifying as lesbian or gay had a significantly and substantially higher prevalence of mental disorders compared to their heterosexual counterparts (Semlyen et al., 2016). One systematic review focusing on the differences between sexual minority subgroups included 52 studies on standardized measures of anxiety and depression in heterosexual, gay/lesbian, and bisexual individuals. The review revealed a consistent pattern: heterosexual individuals had the lowest rates of anxiety and depression, followed by gay/lesbian individuals, while bisexual individuals tended to exhibit higher or comparable rates to gay/lesbian individuals (Ross et al., 2018).

One of the most recent meta-analyses comprised population-based studies on the link between sexual minority status and common mental disorders, i.e., depressive disorders, anxiety disorders, alcohol use disorders and suicidality (Wittgens et al., 2022). In total, the meta-analysis included 26 studies published between 2000 and 2020, encompassing a total sample size of over 500,000 participants (Wittgens et al., 2022). Results revealed that, compared to heterosexual individuals, lesbian and gay individuals were about twice as likely, and bisexual individuals were even almost three times as likely to suffer from a mental disorder across all examined diagnostic categories (Wittgens et al., 2022). Differences between sexual

minority and heterosexual individuals were largest for anxiety disorders and suicidality (Wittgens et al., 2022). The meta-analysis also compared the risk of gay and lesbian to those of bisexual individuals suffering from these common mental disorders: Here, the results also showed that bisexual individuals were at higher risk for all four mental health conditions, however the difference was only significant for depression (Wittgens et al., 2022). Notably, not one single comparison in all studies included in this most recent review found the reverse pattern of lesbian, gay or bisexual individuals being significantly less likely to suffer from neither depression, alcohol use disorder, anxiety disorder, nor suicidality compared to heterosexual individuals (Wittgens et al., 2022). This current systematic review in particular summarizes and confirms that LGB individuals continue to experience significantly poorer mental health compared to heterosexual individuals to this day.

1.2.2. Physical Health

While the World Health Organization (WHO) offers a specific definition of 'mental health' (previous section), there is no exact equivalent definition for 'physical health'. However, the WHO's broader definition of health encompasses physical health (World Health Organization, 2024a). According to the WHO, health is "a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity" (World Health Organization, 2024a). Therefore, although 'physical health' lacks a specific standalone definition, it is inherently included in the WHO's comprehensive definition of health, which emphasizes overall well-being beyond the absence of disease or infirmity. This comprehensive definition implies that physical health is a crucial component of overall well-being and goes beyond merely the absence of disease. In practice, physical health refers to the proper functioning of the body and physical systems, including the ability to perform daily tasks without undue fatigue or physical stress, as well as the capacity to enjoy physical activities and exercise (Olu, 2011; World Health Organization, 2024a).

Despite this broad definition of health, empirical and methodologically sound research requires precise working definitions and classifications to ensure a solid basis for comparison and calculations. Just as seen in the definitions of sexual minorities, it's crucial to recognize that

these definitions and classifications of health are also human-made and therefore neither universally valid nor unchangeable. A good example of the mutability of diagnoses of diseases and disorders is that the WHO classified homosexuality as a mental disorder until May 1990 (World Health Organization, 2019).

To establish a solid foundation for working definitions of physical health, it is sensible to rely on globally established classifications. Therefore, this thesis uses the classification from the Global Burden of Disease (GBD) project to investigate potential physical health disparities (systematic reviews, Studies I and II). The GBD project is a comprehensive research initiative focused on measuring and analysing the worldwide impact of diseases, injuries, and risk factors on population health (Institute for Health Metrics and Evaluation, 2020). It was launched in the 1990s by the WHO, the World Bank, and Harvard University, and today it is a continuous project coordinated by the Institute for Health Metrics and Evaluation (IHME) at the University of Washington, regularly updated to provide the latest information on global disease burden (Institute for Health Metrics and Evaluation, 2020). The GBD project draws from sources including the International Classification of Diseases (ICD), suggesting that this renowned classification covers the vast majority of relevant physical health conditions, ensuring a suitable basis for the thesis' systematic reviews.

Physical Health in Lesbian, Gay, and Bisexual Individuals

Despite ample evidence of mental health challenges within LGB communities, research regarding their physical health has been limited for a long time (Lick et al., 2013). Between 1980 and 1999, out of nearly 4 million studies on physical health published in English, only 0.1% focused on LGB participants, with few examining health outcomes unrelated to HIV/AIDS (Boehmer, 2002; Lick et al., 2013). Recognizing this gap, the U.S. Department of Health and Human Services prioritized LGB health in its Healthy People Initiative through 2020 (Lick et al., 2013). Also, within the 17 Sustainable Development Goals (SDGs) of the United Nations, aspects concerning the health of LGB individuals are anchored, particularly in two of the Goals, i.e., 'Reduced Inequalities' (SDG #10) and 'Good Health and Well-Being' (SDG #3) (United Nations, 2015). Goal 10 explicitly identifies sexual orientation as a discrimination risk to be eliminated, and in Goal 10.2, social inclusion of all individuals regardless of (ascribed) categorizations is emphasized (United Nations, 2015). Similarly, Goal 3 addresses health inequalities, with

reducing such disparities being a central focus of this sustainable goal (United Nations, 2015). The WHO underscores that the adoption of the 2030 Agenda for Sustainable Development, with its commitment to 'leave no one behind' under the framework of international human rights law, highlights the imperative to enhance the health and well-being of LGBTIQ+ individuals (World Health Organization, 2024b).

Due to these institutional efforts and increased recognition of LGBTIQ individuals in political and societal debates, there has been a notable rise in studies since the millennium focusing on the prevalence of physical diseases among sexual minority individuals compared to heterosexual individuals (Lick et al., 2013). In a narrative review on minority stress and physical health in LGB adults, Lick et al. (2013) report that, in the context of the Healthy People Initiatives, almost two dozen empirical studies were conducted up to 2013, comparing the prevalence of non-HIV-related physical health conditions in LGB with those of heterosexual individuals. Over the past decade, this trend has persisted, resulting in a higher density of these empirical data. In particular, large-scale regional (e.g., California Health Interview Survey, CHIS) and national (e.g., National Health Interview Survey, NHIS; Behavioral Risk Factor Surveillance System, BRFSS) representative health surveys in the United States have included items on sexual identity, allowing for deduction and comparison of prevalence data for various sexual identity groups (Heslin, 2020; Singer et al., 2020; Wolstein et al., 2018). For example, it has been reported that, compared to heterosexual women, lesbian and bisexual women report higher rates of, among others, arthritis (Kim & Fredriksen-Goldsen, 2012; Patterson & Jabson, 2018), asthma (Blosnich et al., 2014; Fredriksen-Goldsen et al., 2012; Gao & Mansh, 2016; Patterson & Jabson, 2018), back pain (Fredriksen-Goldsen, Kim, Shui, et al., 2017), chronic bronchitis (Patterson & Jabson, 2018; Strutz et al., 2015), and headache disorders (Heslin, 2020; Strutz et al., 2015). Regarding gay and bisexual men, higher rates of, among others, asthma (Patterson & Jabson, 2018; Stupplebeen et al., 2019; Wolstein et al., 2018), cancer (Boehmer et al., 2014; Kamen et al., 2014), chronic bronchitis (Patterson & Jabson, 2018), and headache disorders (Heslin, 2020; Strutz et al., 2015) have been reported compared to heterosexual men.

However, comprehensive systematic reviews summarizing these data are not yet available to the same extent and scope as they are for mental health. Regarding women, there are three examples of systematic reviews comparing the prevalence of a few selected physical

health conditions in lesbian and bisexual women with those in heterosexual women (Eliason, 2014; Meads et al., 2018; Simoni et al., 2017). One found that out of five health problems only asthma was more common in lesbian and bisexual women, whereas, overall, no significant differences were found for diabetes, hypertension, cardiovascular disease (CVD), and most cancers (Eliason, 2014). The most recent review, including meta-analysis, comprised data on four health conditions and found similar results, i.e., higher asthma rates in lesbian and bisexual women but no differences in cardiovascular diseases, diabetes mellitus, or hypertension (Meads et al., 2018). The third review found that in the 11 studies included, almost every comparison was in a direction indicating physical health disparities (e.g., asthma, arthritis) to the detriment of lesbian and bisexual women, albeit with varying degrees of significance (Simoni et al., 2017).

Since these earlier reviews, a considerable number of new studies have been published, reflecting a fortunate increase in studies in recent years. Additionally, the previous reviews focused only on a few specific diseases (e.g., cancer, CVDs, diabetes) and did not cover a wide range of physical health conditions. They also did not use specific classifications of diseases and, furthermore, did not differentiate between various dimensions of sexual orientation.

Regarding men, to the best of my knowledge, there is no systematic review at all on the prevalence of non-HIV-related physical health conditions in gay and bisexual men compared to the prevalence in heterosexual men.

To summarize, systematic reviews and meta-analyses on the prevalence of physical health conditions are sparse and not comprehensive regarding lesbian- and bisexual-identified compared to heterosexual-identified women, and are lacking completely regarding gay- and bisexual-identified compared to heterosexual-identified men. Therefore, one of the main aims of this thesis (see also Chapter 2) is to approach this research gap by providing a comprehensive summary of the status quo of physical health conditions in LGB-identified individuals compared to heterosexual-identified individuals. Therefore, two systematic reviews, one on women and one on men, including meta-analyses will be conducted.

As one main factor potentially influencing the health of sexual minority individuals, ‘minority stress’ will be introduced in the next section.

1.2. HEALTH IN LESBIAN, GAY, AND BISEXUAL INDIVIDUALS

1.3. MINORITY STRESS

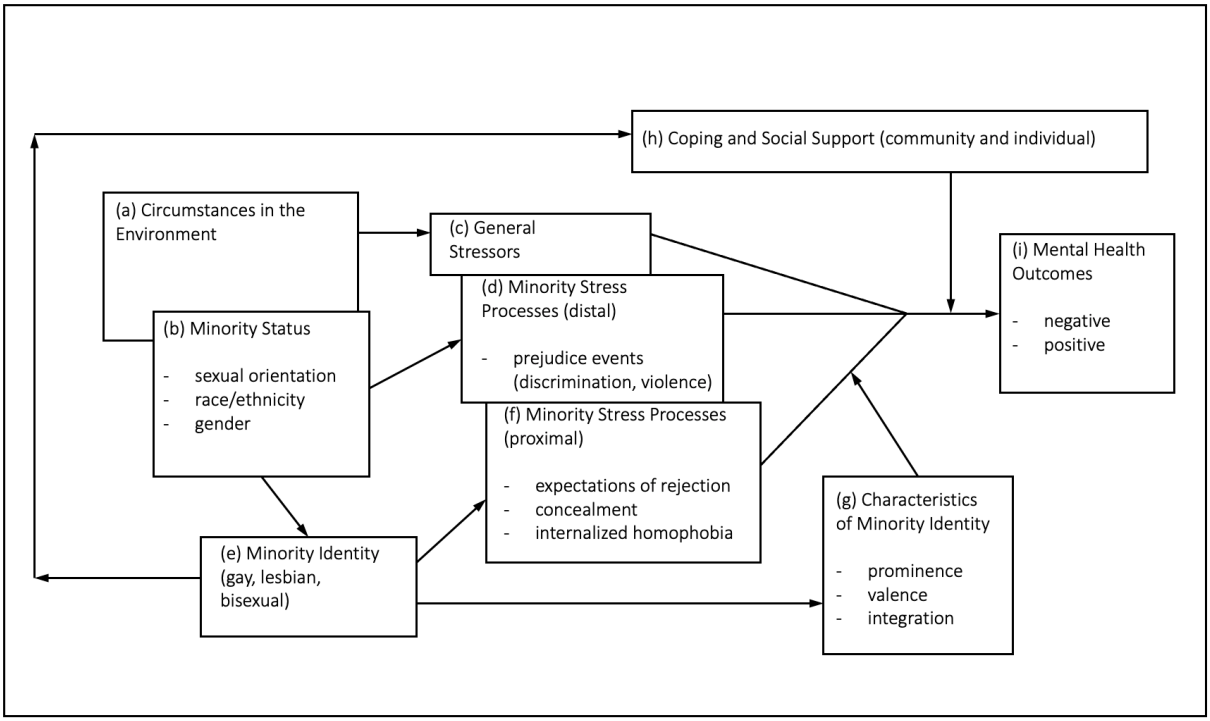
The term ‘minority stress’ was primarily coined by Ilan H. Meyer, although it was first mentioned by Virginia R. Brooks in 1981 (Brooks, 1981; Meyer, 1995). Brooks initially defined minority stress as “psychosocial stress derived from minority status” (Brooks, 1981).

More than a decade later, about 30 years ago, Meyer conducted his first pioneering study on minority stress and its psychological impact on gay men (Meyer, 1995). In this study, minority stressors, arising from societal stigmatization, encompassed (a) internalized homophobia (directing societal negative attitudes towards the self), (b) stigma (expectation of rejection and discrimination), and (c) discrimination (actual experience of discrimination and violence). The mental health effects of these stressors were tested in a sample of 741 gay men in New York City, confirming significant links between the minority stressors and various mental health measures. Notably, high levels of minority stress were associated with a two- to three-fold increase in the likelihood of experiencing high levels of distress (Meyer, 1995).

Based on these and subsequent study findings, Meyer later proposed a conceptual framework (Figure 1) for understanding how stigma, prejudice, and discrimination generate a hostile and stressful social environment, resulting in mental health problems for those suffering from minority stress (Meyer, 2003).

Figure 1.

Minority Stress Processes in Lesbian, Gay, and Bisexual Populations



Note. Own illustration. Figure adopted from Meyer (2003).

The model (Figure 1) demonstrates the relationship between stress, coping and mental health outcomes within groups with minority status, particularly among gay, lesbian and bisexual individuals. The overlapping boxes (a) and (b) emphasize the influence of environmental circumstances (box a), such as socioeconomic factors or acceptance by a society, on the individuals' experiences as part of a minority group (box b). These circumstances interact closely, shaping an individual's exposure to stress and coping resources (Meyer, 2003).

Central to the models are stressors faced by the minoritized individuals. These stressors can be general (box c), potentially affecting all people, such as job loss or loss of a family member, or specific to minority status (box d and f), like discrimination in employment or violent attacks against minoritized individuals (Meyer, 2003). While general stressors are often temporary (e.g., job loss, illness), minority stressors tend to endure over time. This longevity partly derives from the institutionalization of minority stressors within sociocultural and

political systems, making them potentially chronic or at least less alterable by individual effort (Hoy-Ellis, 2023; Meyer, 2003). Within the model, an important distinction regarding minority stress is the differentiation between distal and proximal minority stressors: Distal stressors are *external* events (box d) that are psychologically challenging, including victimization and structural forms of stigma, such as, for example, inequalities in adoption rights, harassment or violent attacks (Meyer, 2003). Proximal stressors are *internal* processes (box f) triggered by experiences of victimization and stigma, such as expectations of rejection, concealment (i.e., balance between disclosure or hiding of sexual orientation), or internalized homophobia (i.e., negative attitude towards the self because of sexual orientation).

According to the model, another important variable that further impacts minority stressors is personal identification with the minority status (box e). For instance, when personal identification with minority status is higher, internalized homophobia is often perceived as worse. In contrast, if being lesbian, gay, or bisexual is not a significant, prominent part of one's identity, then the likelihood of attributing or internalizing potential societal homophobia decreases (Meyer, 2003). This example demonstrates the significance of the characteristics of minority identity (box g) in this interplay, since those characteristics can augment or weaken the impact of stress (Hoy-Ellis, 2023; Meyer, 2003). Among the characteristics are not only the prominence of the identity just mentioned (the importance of the minority identity to an individual's overall self-identity), but also factors like valence, which refers to a positive or negative evaluation of oneself regarding that identity (Hoy-Ellis, 2023; Meyer, 2003). Thus, depending on its form of manifestation, minority identity can also serve as a source of strength (box h), providing opportunities for affiliation, social support, and coping. For example, a positive evaluation of the LGB identity can lead to greater community connectedness, which may mitigate negative health outcomes resulting from minority stress (Meyer, 2003; 2015).

As outlined by the model all these intertwined factors collectively shape mental health outcomes as the model's main outcome (box i) (Meyer, 2003).

The just-illustrated landmark approach by Meyer remains widely prevalent in the literature to this day (Herek & Garnets, 2007; Hoy-Ellis, 2023) and can be summarized as follows: The minority stress theory states that experiencing discrimination and stigma, or even the fear of experiencing discrimination and stigma, can trigger feelings of distress, which can

have profound consequences for personal mental well-being (Meyer, 2003). In this context, minority stress is understood as the accumulation of distal (external events) and proximal stressors (internal processes) over the lifespan, which may overwhelm an individual's coping strategies and adversely affect their health (Lick et al., 2013; Meyer, 2003).

Thus, in its definition, it is explicitly anchored that minority stress triggers distress with the potential to harm a person's mental well-being. What empirical findings has research already yielded with regard to minority stress and its association with mental health?

1.3.1. Minority Stress in Relation to Mental Health

There is already a considerable amount of research examining minority stress in relation to mental health, particularly psychological distress. In alignment with Meyer's model, the vast majority of these studies confirm the postulated positive association between various minority stressors and psychological distress (Hoy-Ellis, 2023). The subsequent section provides an overview of this existing research, initially focusing on distal minority processes, such as discrimination and violence (box d, Figure 1), followed by proximal minority processes, such as expectations of rejection, concealment, and internalized homophobia (box f, Figure 1).

Already in the 1990s, in the previously cited initial study by Meyer, discrimination/violence (prejudice) emerged as an independent, singular, and significant predictor of psychological distress among the 741 gay men in New York City (Meyer, 1995). Furthermore, in subsequent studies, gay men were found to be more prone to experiencing distress due to not attaining an ideal masculine body image if they had been subjected to a physical attack because of their sexual orientation (Kimmel & Mahalik, 2005). Another study found that discrimination experiences predicted substance use: for every additional unit of discrimination encountered, participants were 0.92 times more likely to use their most frequently used drug compared to those who had not experienced discrimination (Hatzenbuehler et al., 2008). A further study confirmed that LGB victimization both directly and indirectly predicted substance use as well as mental health problems such as depressive and anxious symptoms (Lehavot & Simoni, 2011).

With regard to living areas, studies have indicated that LGB individuals living in environments where they face more social stigma encounter frequent stressors (Lick et al., 2013; Lick et al., 2012; Oswald et al., 2010), resulting in elevated levels of psychological distress, such as depressive symptoms and suicide attempts (Goldberg & Smith, 2011; Hatzenbuehler, 2011; Lick et al., 2013; Lick et al., 2012). Additionally, residing in areas with evident anti-LGB bias (Hatzenbuehler et al., 2020; Lick et al., 2013) or affected by anti-LGB laws has been linked to heightened psychological distress within LGB communities (Hatzenbuehler et al., 2009; Hatzenbuehler et al., 2010; Hoy-Ellis, 2023; Riggle et al., 2010).

Concerning the proximal stressors (box f, Figure 1), there is also considerable evidence pointing in the same direction. However, the findings are not equally consistent across all facets of Meyer's original proximal stressors (expectation of rejection, concealment, and internalized homophobia).

In a review, Charles Hoy-Ellis, for example, concluded that findings with regard to expectations of rejection are mixed (Hoy-Ellis, 2023). While some studies found that these expectations correlate with psychological distress among lesbian women and gay men (Lewis et al., 2003), others found that results differ for groups of varying ethnicities and genders (Hoy-Ellis, 2023): While significant associations between expectation of rejection and psychological stress were found for European Americans as well as African American lesbian women (Lewis et al., 2006), no such relationship was reported among Asian gay men (Chen & Shick Tryon, 2012). Overall, lesbian and bisexual women tend to have higher rates of expecting discrimination compared with gay and bisexual men (Lea et al., 2014).

The relationship between concealment, which involves balancing disclosure or hiding one's sexual orientation, and mental health outcomes is not fully understood so far. Some studies have found an association (Hoy-Ellis & Fredriksen-Goldsen, 2016; Lehavot & Simoni, 2011), while others have not (Balsam & Mohr, 2007; Fredriksen-Goldsen, Emlet, et al., 2013) or have only partially found such an association (Kuyper & Fokkema, 2011). Overall, what can be concluded from previous research is a complex dynamic between concealment and mental health outcomes: While concealing one's sexual orientation may offer short-term protection by avoiding or decreasing potential experiences of discrimination, in the long run, it can be

detrimental to mental health if important aspects of one's identity are denied and remain concealed (Hoy-Ellis, 2023; Meyer, 2003).

While evidence regarding the association between expectations of rejection and concealment with mental health outcomes is mixed (Hoy-Ellis, 2023), the link between internalized homophobia, as another significant proximal stressor, and mental health outcomes is more consistent and well established by empirical evidence (Newcomb & Mustanski, 2010).

In their meta-analytic review on internalized homophobia, Newcomb and Mustanski (2010) synthesized findings from 31 studies involving a total of 5,831 participants. They discovered a significant association between higher levels of internalized homophobia and increased levels of depression and anxiety (Newcomb & Mustanski, 2010). Notably, they applied more rigorous inclusion criteria, focusing specifically on psychiatric depressive and anxiety symptoms, unlike previous studies that examined broader mental health outcomes, such as well-being or self-esteem. Despite this stricter approach, the authors still observed a significant association, underscoring the robustness of the link between internalized homophobia and psychiatric mental health outcomes (Newcomb & Mustanski, 2010).

This detailed description of the relationship between minority stress and mental health was meant to highlight the extensive literature on this connection and was also meant to provide a basis for comparing it with the relatively sparse research on the connection between minority stress and physical health that will be described in the next section. As the literature increasingly acknowledges the interdependence of mental and physical health, this section also aimed to prepare for the planned mediation analysis of this thesis, with mental health functioning as a possible mediator between minority stress and physical health (Study III). The next section will now elaborate on what is known about the less-researched connection between minority stress and physical health.

1.3.2. Minority Stress in Relation to Physical Health

While numerous studies have explored the association between minority stress and mental health outcomes, research on the association between minority stress and physical health outcomes is more scarce (Lick et al., 2013). Due to the significantly smaller number of studies

on physical compared to mental health, it is less feasible to categorize them into the various distal and proximal stressors, as done in the previous section. Therefore, the subsequent section will provide a collective summary of the results for all minority stressors and what is known so far about their relationship with physical health outcomes.

Elevated minority stress, including encounters with discrimination, rejection, and internal homophobia, has been associated with a higher incidence of health problems, such as chronic diseases, and diminished overall health (Frost et al., 2015). Furthermore, it has been shown that LGB adolescents who experienced frequent homophobic remarks suffered significantly more from headaches than those experiencing less frequent remarks (Woodford et al., 2012). Another study found that victimization across the lifespan, and financial barriers to healthcare, as well as limited physical activity, independently predicted poorer general health and disabilities in daily functioning among older LGB adults (Fredriksen-Goldsen, Emlet, et al., 2013). In this study, social support and social networks functioned as protective factors, weakening the detrimental health effects (Fredriksen-Goldsen, Emlet, et al., 2013).

An important recent systematic review examined the relationship between minority stress in sexual minorities and various biological outcomes (Flentje et al., 2020). These outcomes encompassed not only diagnosed diseases and overall physical health but also critical biological function, which, if impaired, can lead to clinical consequences and manifestation in (chronic) diseases. Among these biological functions were inflammation, immune function, cardiovascular function, metabolic function, and endocrine/hormonal function (Flentje et al., 2020). In 42% of all analyses, a significant relationship between minority stress and a biological outcome was found. In summary, minority stress was linked to several aspects of physical health, including respiratory infection rates, immune response, HIV-related outcomes, cardiovascular changes, BMI, cortisol levels, as well as cancer incidence and side effects of treatment (Flentje et al., 2020). The authors mentioned particularly striking results from studies finding that acute exposure to a minority stressor led to immediate changes in the blood cell count (Hengge et al., 2003) and the development of subsequent respiratory infections (Cole et al., 1996). Overall, they highlighted immune function, cancer, and cardiovascular function as particularly promising areas for future research (Flentje et al., 2020).

In terms of scope, the review's authors concluded that research in this area is still scarce, as they identified only 26 studies exploring the relationship between minority stress and biological outcomes up to November 2018, despite applying a broad definition of these biological outcomes (Flentje et al., 2020). Furthermore, the authors note that most studies have focused on individual components of minority stress separately rather than testing these processes collectively in one model or as latent variables. Hence, they propose doing so in future studies. Additionally, they advocate for considering other dimensions to discrimination, such as ethnic and racial aspects, in research on minority stress in sexual minorities and its potential health effects (Flentje et al., 2020).

Thus, when analysing minority stress and its potential detrimental mental and physical health effects, it is important to consider that minority stress can affect people for multiple reasons, often simultaneously on more than one dimension—a phenomenon referred to as 'intersectionality'. One of the key criticisms of the original minority stress model, both self-acknowledged (Meyer, 2003) and expressed by others (Hoy-Ellis, 2023) is its neglect of intersectionality. Therefore, the vital importance of incorporating intersectional perspectives in research on minority stress is elaborated in the next section.

1.3.3. Intersectionality

The term 'intersectionality' originates from the American lawyer, legal scholar and Black[4] (Ogette, 2020) feminist Kimberlé Crenshaw and was first introduced by her in 1989 (Crenshaw, 1989). Intersectionality describes the simultaneous interaction of structural dimensions, that, when combined, can collectively constitute social inequality and specific experiences of discrimination (Crenshaw, 1989). Examples of structural dimensions include sex/gender,

[4] The term 'Black' is capitalized to visibly distinguish it from the adjective 'black'. This underscores that 'Black' is a self-identification that attempts to express the social commonalities arising from the construct of racism, but is not meant to describe an actual colour. Hence, it focuses on shared experiences and by no means on biological commonalities (Ogette, 2020). In essence, it refers to individuals who experience racism. In contrast, '*white*' is written in lowercase and italicized to underscore its status as a social construct and privilege, not an actual skin colour (Ogette, 2020).

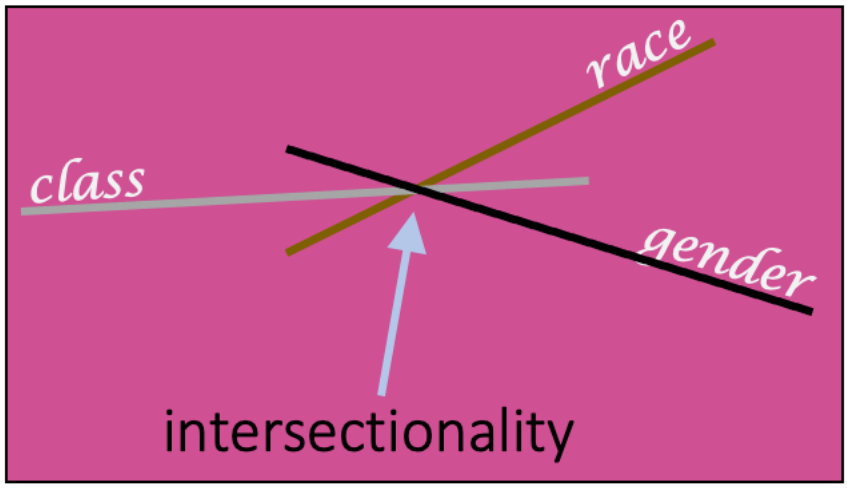
ethnicity, sexual orientation, age, class, etc. A crucial and central point of intersectionality theory is that these dimensions don't add up linearly but intersect in complex ways, and thus create unique experiences of discrimination and social inequality (Bowleg, 2012; Crenshaw, 1989). For example, the (discriminatory) experiences of a Black woman are not the sum of the experiences of all women and all Black people, but rather stem from her unique social position of being a Black woman.

In her original text, Crenshaw cited the case 'DeGraffenreid v. General Motors' from 1976 as an initial example: Emma DeGraffenreid, along with other Black women, sued General Motors for discrimination due to their refusal to hire Black women (Crenshaw, 1989). The court dismissed the lawsuit, stating that General Motors hired both *white* women and Black men. Therefore, the court argued there was neither gender nor racial discrimination. The court contended that Black women were not allowed to combine different forms of discrimination to create a new category of 'Black women' (Crenshaw, 1989). In this example, it is illustrated that intersectional discrimination is not simply the accumulation of gender and racial discrimination, but rather denotes a distinct experience. By introducing the term 'intersectionality', Crenshaw aimed to draw attention to this complexity and intertwining of structural discrimination.

The term 'intersectionality' is derived from the English word 'intersection' (crossing of two or more streets). This metaphor suggests that an individual at the crossroads faces a heightened risk of accidents, surpassing the sum of risks from the individual roads or the sequential traversal of those roads. The term 'accident' in this metaphor represents discrimination and the potential resulting injuries. Figure 2 shows a simplified representation of the interaction of multiple structural dimensions of social inequality using the examples of class, race and sex/gender (Spaynton, 2019). Metaphorically, a Black woman with a low income faces a higher risk of accidents than individuals navigating fewer or none of the paths in a socially disadvantaged position. This includes, for example, *white* women with low income or Black men with high income (medium risk), and particularly *white* men with high income (lowest risk) (Figure 2).

Figure 2.

Intersectionality: Simplified Representation



Note. Own illustration. Figure adopted from Spayton (2019).

It is crucial to emphasize that this is a simplified representation, and many more dimensions need to be added to reflect our complex societal structures, influencing social positioning and the resulting experiences. While Crenshaw originally used the term 'intersectionality' to show how sexism and racism interact to create forms of marginalization specific to Black women, the concept has since been expanded, including additional dimensions to better grasp the interdependence of diverse social inequalities. These additional dimensions include the examples mentioned above (sex/gender, ethnicity, sexual orientation, age, class), as well as others such as religion, abilities, and nationalities, etc.

Analogously to the example of Black women, non-heterosexual People of Colour may encounter unique social inequalities, distinct from the combined experiences of all non-heterosexual individuals and all People of Colour. Intersectionality experts and researchers argue that, for example, health inequalities do not necessarily increase linearly with each additional non-dominant social identity or position (Scheim & Bauer, 2019). In line with this argumentation, a recent study revealed a significant interaction between race/ethnicity and sexual orientation in men, showing increased likelihood of asthma in non-*white* gay men: The non-*white* gay men had by far the highest odds of suffering from asthma compared not only to

heterosexual *white* men but also compared to gay *white* men, as well as heterosexual non-*white* men (Job et al., 2023). Also, with regard to mental health, the aforementioned study in a large sample of college students found an interaction of gender and sexual identity, influencing depression and anxiety scores: Specifically, individuals identifying as both gender and sexual minority were found to have significantly poorer mental health outcomes than those with only one minority identity (Borgogna et al., 2019). In summary, focusing on a single form of discrimination risks obscuring the experiences of individuals facing intersecting forms of discrimination (Scheim & Bauer, 2019). Intersectional approaches aim to counteract this by understanding individuals in their holistic, cross-dimensional identities.

Therefore, in this thesis, minority stress assessment (Study III) will follow an intersectional approach. Since this thesis focuses on the experience of sexual minorities, LGB individuals in particular, we will concentrate on the experience of those individuals. However, the examination of minority stress will encompass the overall minority stress encountered by these LGB individuals, extending beyond discrimination based on non-heterosexuality.

To sum up, the preceding sections on minority stress and health have underscored the well-researched association between minority stress and mental health outcomes, contrasting with the relatively limited evidence regarding its impact on physical health outcomes. Additionally, the importance of incorporating intersectionality into future studies has been emphasized. Deriving from this, Charles Hoy-Ellis succinctly summarizes in his recent review on minority stress and mental health what should be of particular interest for the next steps in this research area:

> "Revising the [minority stress] model to account for intersectional versus categorical identities; […] and; extending the model to account for physical and social health in addition to mental health outcomes would further our understanding of LGBT health disparities." (Hoy-Ellis, 2023, p.819)

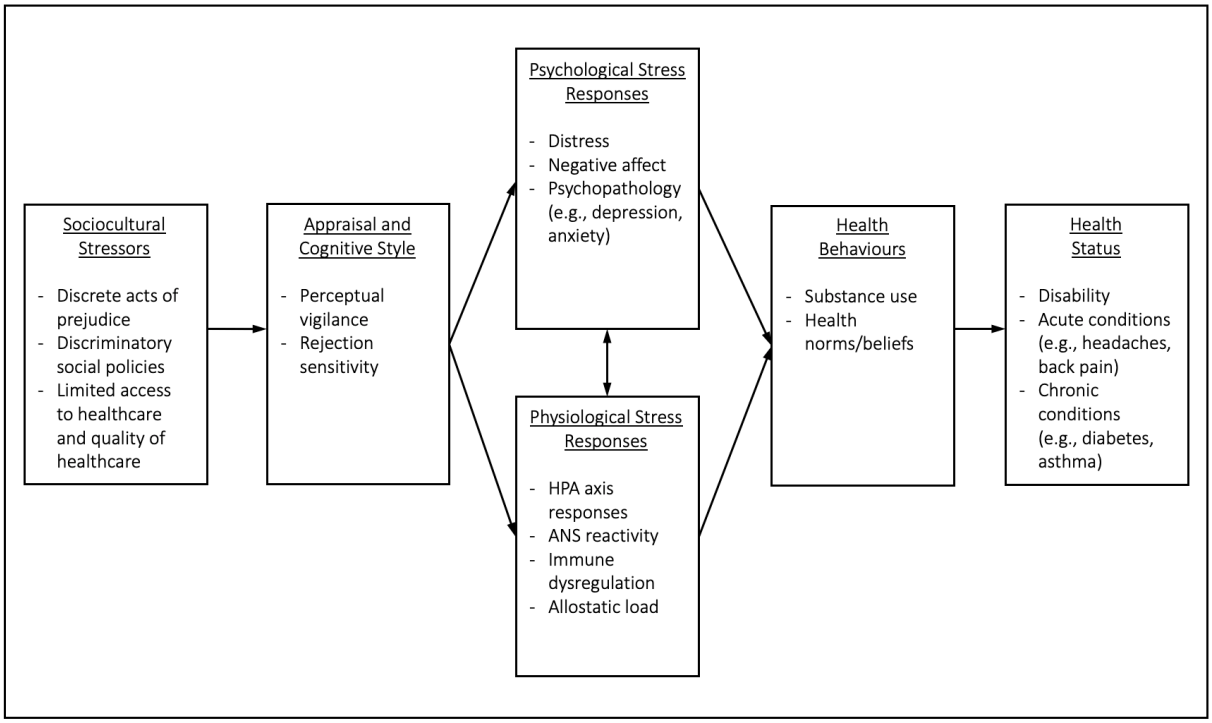
Such a proposal on incorporating physical health aspects into the minority stress model was suggested by Lick et al. (2013). The model by Lick, specifically the aspects relevant to this thesis and their adaptations, will be presented in the following paragraph.

1.4. POTENTIAL MEDIATORS BETWEEN MINORITY STRESS AND HEALTH: PSYCHOLOGICAL FACTORS

Building upon Meyer's original minority stress model (Meyer, 2003), Lick et al. (2013) proposed an extension that incorporates physical health aspects and illustrates potential mediators and pathways between minority stress and physical health (Figure 3).

Figure 3.

Conceptual Model on Mechanisms between Minority Stress and Physical Health



Note. Own illustration. Figure adopted from Lick et al. (2013).

Briefly put, the depicted model (Figure 3) illustrates that minority stress, divided into *Sociocultural Stressors* (distal stressors) and *Appraisal Cognitive Style* (proximal stressors) influences *Health Behaviours* and subsequently *Health Status.* This effect of minority stress on physical health outcomes is mediated by *Psychological* as well as *Physiological Stress Responses* (Lick et al., 2013).

The authors emphasize that this model is conceptual, with some associations not empirically investigated yet. They encourage colleagues to test the proposed mechanisms or pathways (Lick et al., 2013). Following this call to action and the aforementioned claim made by Hoy-Ellis (see quote in the last section extracted from Hoy-Ellis, 2023), this thesis will investigate how intersectional minority stress, mediated by psychological factors, is linked to physical health. The focus will be on the psychological aspect of Lick's model (2013), specifically concentrating on psychopathological stress responses and resilience as potential mediators. Furthermore, health literacy (located in 'health norms/beliefs' in health behaviour in Lick's model) will be included as another mediating variable. Next, these three mediators (psychopathological stress responses, resilience, and health literacy) will be introduced along with what is already known about their interconnections and their relation to minority stress and physical health, respectively.

1.4.1. Psychopathological Stress Responses

As Meyer (2003) has already established in his definition of minority stress, the author posits that minority stress can trigger feelings of distress. Ridner (2004) gathered various approaches and definitions in a comprehensive analysis on psychological distress and described it as "the unique discomforting, emotional state experienced by an individual in response to a specific stressor or demand that results in harm, either temporary or permanent, to the person" (Ridner, 2004, p.539). The author describes the following factors as *prerequisites* for experiencing distress*:* If an individual is exposed to a *stressor* perceived as a *personal threat*, this can lead to a sense of *loss of control*. If there are no effective ways to respond to this loss of control (*ineffective coping*), this results in psychological distress (Ridner, 2004). Ridner (2004) further defines five attributes of psychological distress: perceived inability to cope effectively, changes in emotional status, discomfort, communication of discomfort, and (permanent) harm.

In the context of minority stress, experiences such as discrimination, stigma, or homophobia, or the fear thereof (Meyer, 2003), can be understood as *stressors* that, when perceived as *personal threats* leading to a *loss of control*, trigger *psychological distress*. The fact that minority stressors are often prolonged and/or recurrent (Hoy-Ellis, 2023) increases the

likelihood of psychological distress becoming pathological, resulting in psychopathological stress responses (Ridner, 2004). Hence, psychopathological stress responses refer to disordered or abnormal reactions to stressors, like external events or situations demanding adjustment or adaptation (Christopher, 2004). The most common manifestations of psychopathological stress responses are depressive and anxiety symptoms (Christopher, 2004). The ample evidence on the relationships among the various minority stressors and mental health outcomes, such as psychological distress as well as depressive and anxiety symptoms, has been reported in the section 'Minority Stress in Relation to Mental Health'.

Regarding physical health outcomes, various studies across different populations have linked heightened distress to adverse health outcomes (Lick et al., 2013): For instance, research has shown associations between heightened stress responses and immune system dysfunction (Miller & Chen, 2010), reduced antibody responses post-vaccination (Segerstrom & Miller, 2004), increased susceptibility to colds, the flu, and headaches (Cohen et al., 1991; DeLongis et al., 1988), as well as higher vulnerability to heart diseases and cancer (Cohen et al., 2007). Notably, a study from the U.S. revealed that the increased distress experienced by sexual minority individuals compared to their heterosexual counterparts accounted for some of the physical health disparities observed between gay and heterosexual men, as well as most of the disparities between lesbian and heterosexual women (Cochran & Mays, 2007). A similar study from the Netherlands also demonstrated that differences in the total number of acute and chronic physical health issues between LGB and heterosexual individuals disappear after controlling for psychological distress (Sandfort et al., 2006).

1.4.2. Resilience

'Resilience' refers to the ability of an individual to survive, thrive, and successfully develop in the face of adversity (Meyer, 2015). It encompasses factors that contribute to positive adaptation to (minority) stress, mitigating potential negative impacts on health (Meyer, 2015). Despite not being part of Lick's model, this thesis will integrate resilience to address the often deficit-oriented research on minority stress and health (Meyer, 2015) by adding a resource-oriented component.

Resilience is related to the concept of 'coping'. Both concepts involve ameliorating the negative impact of stress on health. However, coping reflects an individual's active effort to adapt to stress, which may or may not result in successful adjustment, while resilience is inherently linked to successful adaptation by definition. For instance, one can observe active efforts toward successful coping strategies, whereas resilience is identified by its positive—or the absence of negative—health effects during stressful conditions (Masten, 2007).

In resilience research, resilience is not understood in opposition to or antithetical to stress theory; on the contrary, it is considered an integral part of stress theory (Meyer, 2015): According to stress theory, the impact of stress on health is determined by the opposing effects of pathogenic stress processes (such as psychopathologic stress responses) and salutogenic processes (such as resilience). Similarly, resilience can be understood as an essential component of the minority stress theory, implying that resilience gains significance specifically in the presence of (minority) stress and thus can contribute substantially to the understanding of minority stress in health contexts. This idea was also summarized by Luthar, Cicchetti & Becker (2000): "The term 'resilience' should always be used when referring to the process or phenomenon of competence despite adversity" (Luthar et al., 2000). In the context of minority stress and health, resilience can act as a suppressor. In this case, the stressor 'activates' the 'resilience buffer'. For example, a homophobic attack on a sexual minority person can enhance the social support the person receives from the community, thereby mitigating potential negative health consequences (Meyer, 2015; Wheaton, 1985).

In the realm of minority stress and health among sexual minorities, Meyer (2015) distinguishes between 'individual resilience' and 'community resilience'. Individual resilience refers to qualities that strengthen an individual's agency, including concepts that have long been established in the literature, such as 'locus of control' (Rotter, 1966) or 'sense of coherence' (Antonovsky, 1979). Contrastingly, community resilience refers to how communities enhance an individual's abilities. Thus, an individual's competence and resilience on a community level are reinforced by the sense of being able to overcome life challenges, *because* of feeling part of a closely-knit social network (Meyer, 2015). According to Meyer (2015), resilience in the context of sexual minority individuals encompasses both individual and

community components. In this thesis, unless stated otherwise, the term resilience consistently refers to Meyer's definition combining both individual and community resilience.

1.4.3. Health Literacy

First mentioned around 50 years ago in the 1970s, the concept of health literacy has undergone continual changes over subsequent decades (Mackert et al., 2015; Simonds, 1974). While initially focusing on functional skills (basic language and mathematical knowledge in a medical context), the understanding of health literacy has evolved to include elements of empowerment, such as effective communication and navigation in complex health systems (Van den Broucke, 2014). In a significant publication around the turn of the millennium, Nutbeam (2000) introduced a classification of health literacy into three sequential levels:

- I. Functional health literacy (ability to obtain and communicate information);
- II. Interactive health literacy (opportunities to develop personal skills in a supportive environment); and
- III. Critical health literacy (personal and community empowerment: opportunity to achieve policy and/or organizational change) (Nutbeam, 2000).

To reflect this development and to integrate existing definitions, an international team of experts led by Kristine Sørensen developed a comprehensive model (Sørensen et al., 2012). This model defines health literacy as "the knowledge, motivation and competences to access, understand, appraise and apply health information in order to make judgments and take decisions in everyday life concerning health care, disease prevention and health promotion to maintain or improve quality of life throughout the course of life" (Sørensen et al., 2012, p.3). Accompanying the comprehensive model, the HLS-EU Scale, a tool for measuring health literacy, was developed to assess the subjective difficulty of health-related tasks in alignment with the provided definition (Sørensen et al., 2012). Despite facing criticism for its subjective nature (as it relies on self-rated assessment), this approach is frequently cited in the literature. This prevalence of the approach is likely attributed to its positive association with objective health outcomes (Berkman et al., 2011; Schaeffer et al., 2017), suggesting that subjective health literacy manifests in a person's health.

For instance, a representative German study with 2,000 participants revealed that among those with excellent subjective health literacy, 95.1% rated their health as ‘good’ or ‘very good’. In contrast, among participants with insufficient subjective health literacy, only 43.8% rated their own health positively (Schaeffer et al., 2017). Furthermore, positive correlations between subjective health literacy and health-promoting behaviours, including dietary habits and physical activity, were found (Schaeffer et al., 2017). Also, in the context of the COVID-19 pandemic in the early 2020s, the link between health literacy and other health outcomes became apparent: higher health literacy levels were associated with more accurate knowledge and awareness of the virus as well as adaption of health protective behaviours (Naveed & Shaukat, 2022), whereas individuals with lower health literacy more frequently endorsed misinformation beliefs about COVID-19 vaccination (McCaffery et al., 2020). Another study found that well-being and self-perceived health status were more strongly associated with subjective health literacy than with health-related knowledge (Gerich & Moosbrugger, 2018). In terms of a self-fulfilling prophecy, this suggests that the individual’s subjective perception of their own health-related competence may even outweigh their actual knowledge of health-related topics in its significance for the individual’s health status (Gerich & Moosbrugger, 2018). Additionally, within this study, subjective health literacy and health-related knowledge were only weakly correlated (Gerich & Moosbrugger, 2018).

To gain deeper insights into the factors contributing to low or high levels of subjective health literacy beyond health-related knowledge, Gerich and Moosbrugger (2018) examined potential factors influencing subjective health literacy scores. They discovered that individuals with high subjective health literacy were characterized either by high personal and social resources, such as high self-efficacy, active coping, or internal locus of control, or by high trust in doctors and healthcare professionals (Gerich & Moosbrugger, 2018). Hence, the authors conclude that subjective health literacy is a measure of how patients perceive the ‘manageability’ of health-related tasks. A high level of ‘manageability’ may result from either elevated personal resources and abilities (e.g., high self-efficacy, active coping or resilience) or a strong trust and adherence to healthcare professionals and experts (Gerich & Moosbrugger, 2018). To score high on subjective health literacy, individuals must either feel in control of their own health or trust someone (e.g., a doctor) whom they believe has control over their health

(Gerich & Moosbrugger, 2018). In relation to the other two psychological factors in this study, this could suggest the following: Psychopathological stress responses, characterized by feelings of hopelessness and low self-efficacy (thus low manageability), could negatively impact health literacy. In contrast, resilience, characterized by high personal capacities (thus high manageability), could positively affect health literacy.

1.5. SHORT OVERVIEW OF STATE OF RESEARCH AND RESEARCH GAPS

The following brief overview aims to summarize the main aspects presented in the first introductory chapter regarding the state of research, including the research gaps that will be addressed in this thesis.

Concerning health disparities between sexual minority individuals and heterosexual individuals, the following has been described:

- There is already extensive literature demonstrating significant mental health disparities between LGB individuals and heterosexual individuals (Wittgens et al., 2022). Comprehensive systematic reviews and meta-analyses also confirm higher rates of conditions such as depression and anxiety disorders among sexual minority individuals (Plöderl & Tremblay, 2015; Ross et al., 2018; Wittgens et al., 2022).
- Regarding studies examining potential physical health disparities, there has been a notable increase in recent years in studies comparing the prevalence of physical health conditions between LGB and heterosexual individuals (Heslin, 2020; Lick et al., 2013; Singer et al., 2020; Wolstein et al., 2018). However, unlike mental health, comprehensive systematic reviews and meta-analyses summarizing these findings systematically are still sparse (for women), to non-existent (for men).

→ Therefore, the first research gap to be addressed within the thesis is the comprehensive and systematic review of studies comparing the prevalence of physical health conditions between LGB individuals and heterosexual individuals.

Furthermore, in the context of minority stress and potential health consequences for sexual minority individuals, the following has been described:

- The relation between minority stress and mental health has been thoroughly documented in the literature, particularly concerning depressive and anxious symptoms, with significant effects of minority stress observed on these symptoms (Hoy-Ellis, 2023).
- In contrast, the relation between minority stress and physical health is significantly less researched. Lick et al. (2013) propose a theoretical model suggesting that the well-established link between minority stress and psychological factors/mental health (Hoy-Ellis, 2023), along with the connection between mental health and physical health (Cohen et al., 2007; Miller & Chen, 2010), serves as a primary mediation pathway. However, many pathways of this model have not yet been sufficiently empirically tested, particularly in comprehensive, combined structural equation models (Hoy-Ellis, 2023; Lick et al., 2013). Moreover, resource-oriented perspectives (e.g., resilience) are frequently given less attention in studies dealing with minority stress and physical health (Meyer, 2015).
- Intersectionality, as an important concept to account for multiple interacting experiences of discrimination (Crenshaw, 1989), has so far been insufficiently considered in the context of minority stress and health (Hankivsky, 2012; Krieger, 2019).

→ Therefore, the second research gap that this thesis aims to address is to empirically examine the effects of minority stress on physical health—focusing on psychological factors and mental health as mediating factors—in order to empirically analyse parts of Lick's theoretical model. In doing so, an intersectional perspective will be considered to address the gap of insufficient incorporation of intersectional perspectives in health research among LGB individuals, while also emphasizing the importance of including resource-oriented perspectives such as resilience.

The specific research questions and their corresponding hypotheses will be presented in the following chapter.

CHAPTER 2 – THE PRESENT THESIS PROJECT

2.1. AIM OF THE PRESENT THESIS PROJECT

If in a society, health is correlated with inherent characteristics of its members, such as ethnic origin or sexual orientation, it is the responsibility of that society to uncover these health disparities and discover underlying processes that lead to or exacerbate health disparities. Assessing the current status quo of such health disparities, along with analysing mechanisms leading to disparities, are crucial prerequisites towards achieving a discrimination-free society. In this context, 'discrimination-free' should mean that the health status of minority group members cannot be discriminated, that is, distinguished, from the health status of majority members (Latin: discriminare = distinguish, separate, differentiate). Therefore, the overarching aims of the present thesis project are: (I) analysing the status quo of physical health in sexual minority individuals (compared to the majority group of heterosexual individuals) and (II) contributing to uncovering underlying mechanisms leading to physical health disparities for sexual minority individuals. The first aim will be addressed in Research Question I, and the second aim will be addressed in Research Question II.

2.2. RESEARCH QUESTIONS AND HYPOTHESES

Research Question I: What is the status quo of physical health among sexual minority individuals? Specifically, does the prevalence of physical health conditions differ between

(a) lesbian- and bisexual-identified women compared to heterosexual-identified women?

(b) gay- and bisexual-identified men compared to heterosexual-identified men?

Hypotheses:

HIa: There is a higher prevalence of physical health conditions in lesbian- and bisexual-identified women compared to heterosexual-identified women.

HIb: There is a higher prevalence of physical health conditions in gay- and bisexual-identified men compared to heterosexual-identified men.

Research Questions I will be addressed in Study I and II (Chapter 3). In order to test the hypotheses HIa and HIb, a comprehensive systematic review and meta-analyses on physical health conditions in lesbian- and bisexual-identified women compared to heterosexual-identified women (Study I) and gay- and bisexual-identified compared to heterosexual-identified men (Study II) were conducted. Since the two reviews emerged from a shared, parallel process, they will be described jointly in one chapter.

The second aim, contributing to uncovering underlying mechanisms leading to physical health disparities, will be addressed in Research Question II.

Research Question II: Is there a negative total effect of intersectional minority stress on the physical health of lesbian-, gay-, and bisexual-identified individuals? Is the effect mediated by psychopathological stress responses, resilience, and health literary?

Hypothesis:

HII: There is a negative total effect of intersectional minority stress on the physical health of lesbian-, gay-, and bisexual-identified individuals, mediated by psychopathological stress responses, resilience, and health literacy.

More specific hypotheses, e.g., on the mediations of psychopathological stress responses, resilience, and health literacy, will be provided in Study III (Chapter 4).

Research Questions II will be addressed in Study III (Chapter 4). In order to test hypothesis HII, an online-survey-study on minority stress, health outcomes and psychological factors (psychopathological stress responses, resilience, and health literacy) was conducted in lesbian-, gay-, and bisexual-identifying individuals.

CHAPTER 3 – SUMMARY OF STUDY I AND II: SYSTEMATIC REVIEWS AND META-ANALYSES ON PHYSICAL HEALTH CONDITIONS IN LESBIAN, GAY, AND BISEXUAL INDIVIDUALS

3.1. GENERAL INFORMATION

STUDY I

Haarmann, L., Folkerts, A.K., Lieker, E., Eichert, K., Neidlinger, M., Monsef, I., … & Kalbe, E. (2023). Comprehensive systematic review and meta-analysis on physical health conditons in lesbian- and bisexual-identified women compared to heterosexual-identified women. *Women's health, 19*, 1-27. https://doi.org/10.1177/17455057231219610

The first study, the comprehensive systematic review and meta-analysis on physical health conditions in lesbian- and bisexual-identified women compared to heterosexual-identified women, was published in *Women's health.* The manuscript was initially submitted on 29th June, 2023, revised in November 2023, and accepted for publication on 23rd November, 2023.

STUDY II

Haarmann, L., Lieker, E., Folkerts, A.K., Eichert, K., Neidlinger, M., Monsef, I., … & Kalbe, E. (2024). Higher risk of many physical health conditions in sexual minority men: Comprehensive systematic review and meta-analysis in gay- and bisexual-identified compared with heterosexual-identified men. *LGBT health, 11*(2), 81-102. https://doi.org/10.1089/lgbt.2023.0084

The second study, a comprehensive systematic review and meta-analysis on physical health conditions in gay- and bisexual-identified men compared to heterosexual-identified men, was published in *LGBT Health.* The manuscript was initially submitted on 17th March, 2023, revised in May 2023, and accepted for publication on 23rd June, 2023.

3.2. SCIENTIFIC CONTRIBUTIONS

The systematic reviews were conceptualized by **Lena Haarmann**, Ann-Kristin Folkerts, Birgit Träuble, and Elke Kalbe. Ina Monsef conducted the systematic search. **Lena Haarmann**, Ann-Kristin Folkerts, Emma Lieker and Kai Eichert conducted the title and abstract screening in a dual control principle, i.e., each title and abstract was screened by two reviewers. **Lena Haarmann** and Emma Lieker conducted the full-text screening in a dual control principle. **Lena Haarmann**, Kai Eichert and Marlene Neidlinger extracted the data in a dual control principle. **Lena Haarmann** and Emma Lieker conducted the meta-analyses. Nikole Skoetz gave advice. **Lena Haarmann** and Elke Kalbe interpreted the results. Elke Kalbe supervised the project during each stage of the work. **Lena Haarmann** drafted the first version of the manuscript. All authors revised the manuscript for intellectual content and approved the final version of the manuscript. **Lena Haarmann** and Elke Kalbe led the submission process and drafted the revisions until final publication.

3.3. INTRODUCTION

For years, research on the health of sexual minority adults primarily concentrated on STDs, particularly HIV in gay men, and more recently, on mental health (Lick et al., 2013). Regarding mental health, systematic reviews consistently found health disparities to the detriment of sexual minorities compared to heterosexual individuals (Wittgens et al., 2022).. Today, mental and physical health are understood to be interconnected. In various populations, elevated psychological distress has been linked to adverse physical health outcomes (Cohen et al., 2007; Cohen et al., 1991; Miller & Chen, 2010; Segerstrom & Miller, 2004). Specifically, a U.S. study found that the heightened distress among sexual minority adults compared to heterosexual adults explained most of the physical health disparities between lesbian and heterosexual women, as well as some of the disparities between gay and heterosexual men (Cochran & Mays, 2007).

Only recently, studies focusing on the prevalence of physical diseases in LGB individuals compared to heterosexual individuals have increased notably. However, comprehensive systematic reviews are not yet available to the same extent as for mental health. Regarding women, there are three systematic reviews on a few selected physical health conditions each (Eliason, 2014; Meads et al., 2018; Simoni et al., 2017) and, regarding men, to the best of our knowledge, there is no equivalent systematic review at all. Thus, systematic reviews and meta-analyses on the prevalence of physical health conditions are sparse and not comprehensive regarding lesbian- and bisexual-identified compared to heterosexual-identified women; and are lacking completely regarding gay- and bisexual-identified compared to heterosexual-identified men.

3.4. OBJECTIVES

These studies (Studies I and II) aimed to provide systematic reviews and meta-analyses on the prevalence of physical health conditions, comparing

- lesbian-identified and/or bisexual-identified women, or SMW (lesbian- and bisexual-identified aggregated), to heterosexual-identified women (Study I)
- gay-identified and/or bisexual-identified men, or SMM (gay- and bisexual-identified aggregated), to heterosexual-identified men (Study II).

3.5. METHODS

The conduct and reporting of studies I and II followed the PRISMA guideline for systematic reviews and meta-analyses (Moher et al., 2009). The project was preregistered in the Prospero database (CRD42021281490).

Study eligibility and inclusion criteria

For physical health conditions, we utilized the Global Burden of Disease (GBD) classification. The GBD is a comprehensive research program assessing mortality and disability from major diseases, injuries, and risk factors, initiated by Harvard University, the WHO, and the World

Bank (Institute for Health Metrics and Evaluation, 2020). For the systematic reviews, the inclusion were: (i) full-text epidemiological studies (cross-sectional or cohort studies); (ii) published in English or German; (iii) published between 01/01/2000 and 27/02/2021; (iv) comparing lesbian-identified (lesbian) and/or bisexual-identified (bisexual) women, or SMW (lesbian- and bisexual-identified aggregated), to heterosexual/straight-identified (heterosexual) women (Study I) *and/or* (v) comparing gay-identified (gay) and/or bisexual-identified (bisexual) men, or SMM (gay- and bisexual-identified aggregated), to heterosexual/straight identified (heterosexual) men (Study II); (vi) reporting prevalence of at least one diagnosed (self-reported or examined) health condition according to GBD classification; and (vii) including participants ≥18 years.

Database search and screening procedure

We conducted an extensive database search in MEDLINE, EMBASE, CENTRAL, CINAHL, and Web of Science. The detailed search string is appended to the original publications. The identified studies were uploaded into the systematic review software Covidence (Veritas Health Innovation, Melbourne, Australia) for abstract and full-text screening that was conducted by two reviewers each. Disagreements were resolved through discussion and/or the involvement of a third reviewer.

Database extraction and synthesis

Data extraction was performed by one reviewer using Excel (Version 16.66.1) extraction sheets, checked by another reviewer, and subsequently double-checked by a third reviewer. The extracted information encompassed the sampling method (including weighting details), dates of data collection, sample sizes, age range, HIV status, assessment of sexual identity, assessment of health conditions, and variables adjusted for. For comparative statistics, we extracted data from studies reporting odds ratios (OR), absolute numbers, or percentages of prevalence (which we used to approximate ORs). If these data were not reported, we requested primary data from the respective authors. If available, we additionally extracted adjusted odds ratios (AOR).

Statistical analysis and meta-analysis

Whenever data from at least two non-overlapping studies per health condition were available, we conducted a meta-analysis on the respective condition. In the meta-analyses, only weighted data were included. Since not all AORs adjusted for the same variables, resulting in reduced comparability, we conducted the meta-analyses on the ORs using Review Manager 5.4. Considering the expected heterogeneity in study designs and samples, random-effects models were calculated using the Mantel-Haenszel method (Borenstein et al., 2021). We ran tests for subgroup differences (lesbian, bisexual, and SMW for women; gay, bisexual, and SMM for men). The significance level was set at $p < .05$, and standard thresholds were applied for heterogeneity (I^2) (Higgins, 2008). We assessed the quality of the studies using the Critical Appraisal Skills Programme (CASP) checklist for cohort studies (Gray, 2023).

3.6. RESULTS

General findings

The database search initially retrieved 28,692 references (flowcharts are provided in the original publications). After removing 5,043 duplicates, the titles and abstracts of 23,649 references were screened, and out of those, 478 were further reviewed during full-text screening. Data was requested from 39 authors. Almost half of those authors (*n* = 17) replied: 12 authors indicated no access to data or data unavailability, while five authors provided data.

Finally, 44 studies were included in the women's review, and 32 studies were included in the men's review. Out of the 44 studies included in the women's review, the majority (39/44) derived from large national or regional representative health surveys, with the remaining (5/44) being single cross-sectional or cohort studies. The included studies encompass data from four countries: the USA (*n* = 39), Australia (*n* = 2), the UK (*n* = 2), and Belgium (*n* = 1). Regarding men, all studies were sourced from large national or regional representative health surveys, with the majority (*n* = 31) originating from the USA and *n* = 1 from the UK.

The total sample sizes of the included studies ranged between *N* = 84 and *N* = 12,640,900 (weighted estimates) for women and *N* = 1,067 and *N* = 12,440,600 (weighted estimates) for men. Information on the study sources, dates of data collection, and sample sizes of each study is displayed in the original publications. Detailed descriptive information on each

study (e.g., sexual identity assessment, health condition assessment, etc.) is provided in the original publication's appendices.

For better readability, the results of the reviews for women and men are presented separately.

3.6.1. Study I: Results of Systematic Review on Physical Health Condition in Women

The 44 included studies comprised a total of 369 relevant comparisons, including 236 ORs and 133 AORs, covering 21 distinct health conditions categorized into these 12 GBD main categories: cardiovascular diseases, chronic respiratory diseases, diabetes and chronic kidney diseases, digestive diseases, maternal and neonatal diseases, musculoskeletal disorders, neoplasms, neurological disorders, nutritional deficiencies, other infectious diseases, other non-communicable diseases, and skin diseases. Meta-analyses were run on eleven conditions.

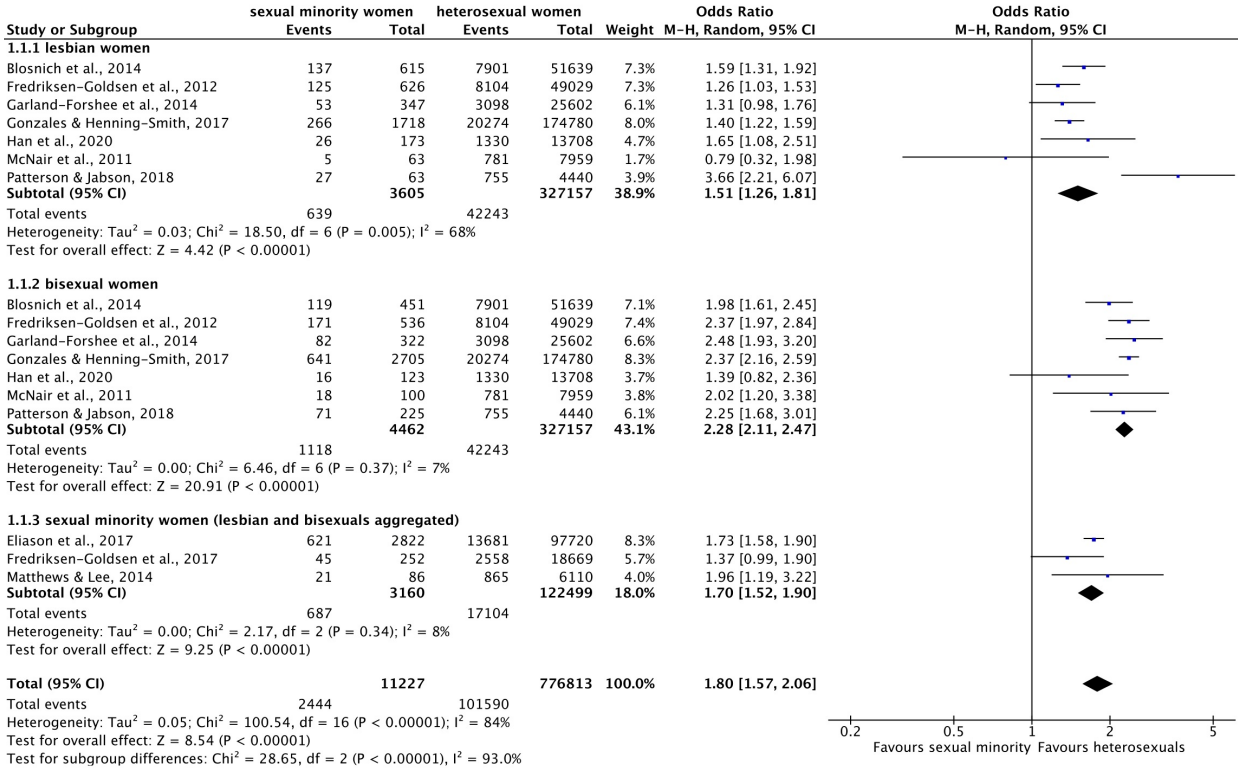
The main results of the women's systematic review were: (i) Most notable differences by sexual identity were observed for chronic respiratory diseases, specifically asthma. Overall, across all subgroups and in nearly all studies, sexual minority women were found to be 1.5–2 times more likely to experience asthma compared to heterosexual women (Figure 4, meta-analysis across subgroups with OR: 1.80, 95% CI: 1.57–2.06, p <.001). The differences in prevalence regarding asthma were larger for bisexual compared to heterosexual women (OR: 2.28, 95% CI: 2.11–2.47, p <.001) than for lesbian compared to heterosexual women (OR: 1.51, 95% CI: 1.57–1.90, p =.005). (ii) A higher prevalence in the sexual minority women compared to heterosexual women was furthermore found with regard to back pain, hepatitis B/C, oral disorders, other chronic respiratory conditions, urinary tract infections, and acne. (iii) Conversely, a lower prevalence was found in sexual minority women compared to heterosexual women for cancer, diabetes, heart attacks and hypertension. We found indications that the lower prevalence of diabetes and hypertension could be attributed to lower pregnancy rates in the sexual minority women compared to heterosexual women. (iv) Regarding chronic kidney diseases, digestive diseases, maternal and nutritional disorders, as well as strokes, lesbian, bisexual, and heterosexual women were about equally affected. (v) Across categories, we identified a trend showing that bisexual women were more affected by some of the stress-

related conditions, e.g., asthma and headache disorders, than lesbian women. (vi) Some of the results rely on a few comparisons or small samples of sexual minority women.

(Note: Since the largest differences were found for asthma, the Forest Plot for the meta-analysis on asthma is depicted here as an example in Figure 4. The remaining ten meta-analyses are provided in the original publication, as well as comprehensive tables including all 369 relevant comparisons that cannot be depicted here due to space constraints).

Figure 4.

Forest Plot: Meta-Analysis on Asthma by Sexual Identity (Women)



Notes. M-H.: Mantel-Haenszel, CI: Confidence Interval. Figure extracted from publication of Study I (Haarmann et al., 2023).

3.6.2. Study II: Results of Systematic Review on Physical Health Condition in Men

The 32 studies included in the men's systematic review comprised a total of 289 relevant comparisons, including 170 ORs and 119 AORs, covering 16 distinct health conditions

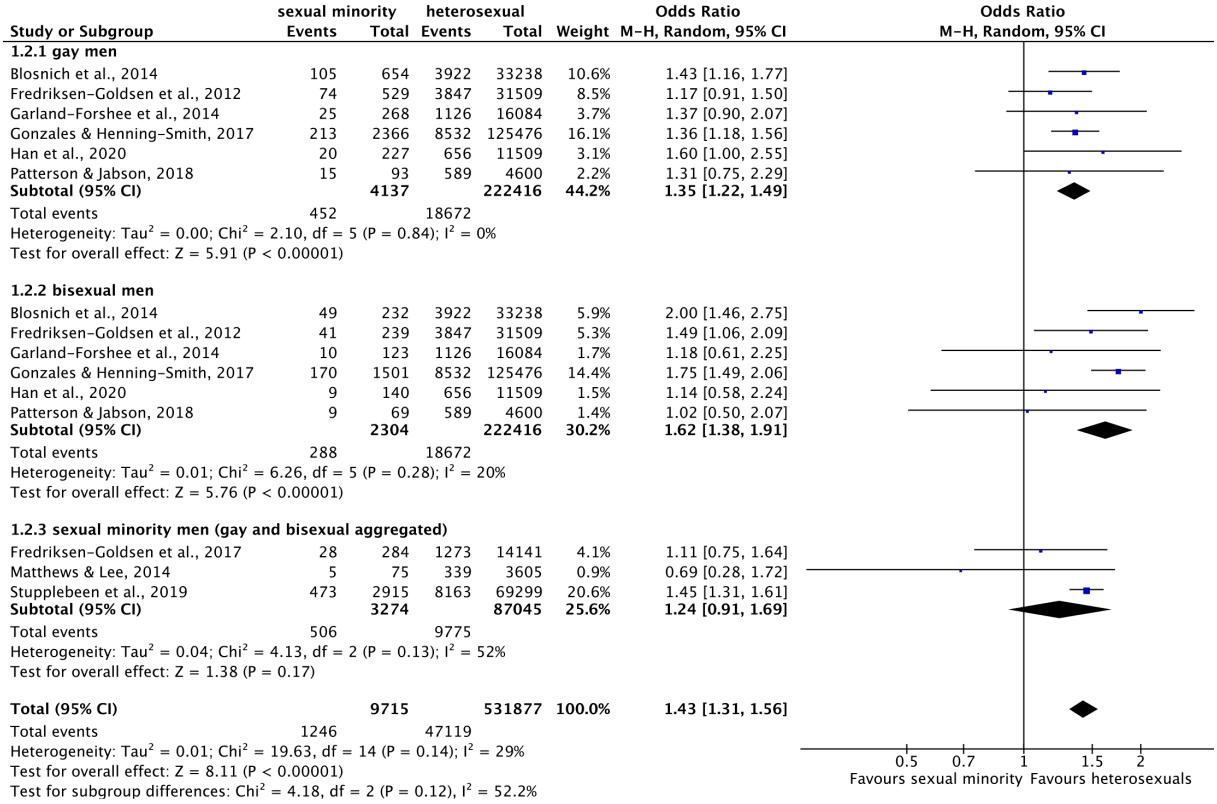
categorized into these nine GBD main categories: cardiovascular diseases, chronic respiratory diseases, diabetes and chronic kidney diseases, digestive diseases, musculoskeletal disorders, neoplasms, neurological disorders, other infectious diseases and other non-communicable diseases. Meta-analyses were run on eleven conditions.

The main results of the men's review were: (i) Similar to the women's review, the most striking differences in prevalence were identified for chronic respiratory diseases, particularly asthma. Overall, across all subgroups and in the vast majority of studies, sexual minority men were significantly, nearly 50%, more likely to suffer from asthma than heterosexual men (Figure 5, meta-analysis across subgroups with OR: 1.43, 95%CI: 1.31–1.56, p <.001). Descriptively, the differences in prevalence regarding asthma were larger for bisexual compared to heterosexual men (OR: 1.62, 95% CI: 1.38–1.91, p <.001) than for gay compared to heterosexual men (OR: 1.35, 95% CI: 1.22–1.49, p <.001). (ii) Furthermore, higher prevalence rates compared to heterosexual men were found for chronic kidney diseases in gay men, headache disorders in gay men, and SMM and hepatitis B/C, and other chronic respiratory conditions in both gay and bisexual men. (iii) Concerning diabetes, musculoskeletal disorders, digestive diseases (one comparison only), and oral disorders (one comparison only), gay and bisexual men had similar prevalence rates as heterosexual men. (iv) With regard to some of the conditions, for example, other cardiovascular diseases and asthma, we found a trend of bisexual men being more affected than gay men. However, regarding cancer, headache disorders and hepatitis B/C, the reverse was found: Here, gay men were more likely to be affected than bisexual men. (v) Some of the results rely on a few comparisons or small samples of sexual minority men.

(Note: Similarly to the women's review, the meta-analysis on asthma is provided here as an example; all other detailed results are available in the original publication.)

Figure 5.

Forest Plot: Meta-Analysis on Asthma by Sexual Identity (Men)



Notes. M-H.: Mantel-Haenszel, CI: Confidence Interval. Figure extracted from publication of Study II (Haarmann et al., 2024).

3.7. DISCUSSION

Studies I and II aimed to provide comprehensive systematic reviews and meta-analyses on the prevalence of physical health conditions by comparing lesbian-identified and/or bisexual-identified women, or SMW (lesbian- and bisexual-identified aggregated), to heterosexual-identified women (Study I), *and* by comparing gay-identified and/or bisexual-identified men, or SMM (gay- and bisexual-identified aggregated), to heterosexual-identified men (Study II). Again, for better readability, the main findings of the reviews for women and men are presented separately.

3.7.1. Study I: Main Findings of Systematic Review on Physical Health Condition in Women

The main findings of the women's review were that sexual minority women were significantly more likely to have asthma and chronic respiratory diseases, along with higher rates of back pain, headache/migraines, hepatitis B/C, oral disorders, urinary tract infections, and acne. Conversely, they exhibited lower prevalence rates of heart attacks, hypertension, diabetes, and cancer than heterosexual women. Bisexual women tended to be more affected by some of the stress-related conditions compared to lesbian women. However, some findings were based on limited comparisons or small samples of sexual minority women.

Previous research has consistently found higher odds of asthma among sexual minority women, reinforcing the robustness of these findings (Meads et al., 2018). Prior research has also linked psychosocial stressors, such as interpersonal stress and discrimination, with heightened asthma risks (Lietzen et al., 2011). Non-heterosexual identity exposes individuals to increased risk of discrimination and thus heightened psychological stress, which in turn can exacerbate asthma symptoms. Additionally, smoking, known to be more prevalent among sexual minority individuals (Fredriksen-Goldsen, Kim, et al., 2013; Job et al., 2023), may have further contributed to the higher prevalence of respiratory conditions. Likewise, environmental factors, such as exposure to hazardous air pollutants, are also heightened for sexual minority individuals, potentially due to residing in areas with more severe air pollution and an associated increase in suffering from chronic respiratory conditions (Collins et al., 2017).

As described, psychosocial stress has been linked to asthma risks, and similar mechanisms may explain higher rates of back pain and headache migraines among sexual minority women. Harassment, discrimination, social isolation and perceived long-term stress have previously been found to increase back pain risks (Puschmann et al., 2020; Yang et al., 2023). Likewise, lower perceived social status, which might be more present in sexual minority women, has been associated with higher odds of migraines in women (Hammond & Stinchcombe, 2019). In previous research, adverse life circumstances and severe mental illness have also been found to contribute to these disparities, supporting the minority stress model's assertion that psychological stress mediates physical health disparities (Burch et al., 2019; Heslin, 2020; Martin, 2016).

The prevalence of hypertension and diabetes was found to be lower in sexual minority women, despite both being stress-related diseases. However, studies excluding gestational diabetes and gestational hypertension, on average, did not find significant differences in prevalence by sexual identity. Taking into account that bisexual and lesbian women are significantly (up to 50% and 90%) less likely to become pregnant (Hodson et al., 2017), the overall lower prevalence of these conditions in sexual minority women might be influenced by these differences in pregnancy rates, given that gestational diabetes affects up to 10% and gestational hypertension up to 13% of all pregnant women (Dunietz et al., 2017).

In our review, bisexual women tended to experience higher rates of stress-related conditions like asthma, back pain, and headaches compared to lesbian women. Previous research consistently shows that bisexual individuals face more mental health issues (Brennan et al., 2010; Conron et al., 2010; Jorm et al., 2002; Semlyen et al., 2016). Unique stressors, including negative attitudes from both heterosexual and gay/lesbian individuals, might also have contributed to increased stress-related physical health conditions, as found in the review.

3.7.2. Study II: Main Findings of Systematic Review on Physical Health Condition in Men

The main findings of the men's review were: Notable differences in prevalence were found for chronic respiratory conditions, particularly asthma, with sexual minority men being more affected than heterosexual men. Higher prevalence was also found for chronic kidney diseases in gay men, headache disorders in gay and SMM, and hepatitis B/C in gay and bisexual men. Bisexual men tended to be more affected than gay men by some stress-related conditions such as cardiovascular diseases and asthma, while the reverse was found for cancer, headache disorders, and hepatitis B/C (gay men more affected). Overall, for none of the conditions, did sexual minority men have significantly lower prevalence rates than heterosexual men.

This systematic review is the first to reveal that gay and bisexual men face a significantly higher risk of chronic respiratory conditions, particularly asthma, compared to heterosexual men. Past research underscores the role of psychosocial stress, such as interpersonal stress and divorce/separation, in asthma development (Lietzen et al., 2011). Gay and bisexual identities and the associated risk of discrimination or offense have to be considered

psychosocial stressors and potential risk factors for asthma. A previous meta-analysis found discrimination affects mental and physical health directly and indirectly through stress and unhealthy behaviours (Pascoe & Smart Richman, 2009). As described in the section on women, smoking is more common among sexual minorities (Fredriksen-Goldsen, Kim, et al., 2013; Job et al., 2023), and may exacerbate respiratory conditions. Minority stressors independently increase smoking likelihood in sexual minority adults (Blosnich et al., 2013; Gordon et al., 2021). Unique risk factors for smoking among sexual minorities include internalized homophobia and reactions to sexual orientation disclosure (Blosnich et al., 2013; Gordon et al., 2021).

Similar mechanisms may explain the increased likelihood of sexual minority men suffering from headaches/migraines. Previous research suggests that lower perceived social status is linked to higher odds of migraines in women (Hammond & Stinchcombe, 2019). Due to their sexual minority status, gay- and bisexual-identifying men may perceive their social status as lower, increasing their risk for headaches/migraines.

Across categories, bisexual men showed a trend of being more affected than gay men by certain conditions. Feinstein and Dyar's review on bisexuality and minority stress demonstrated consistent findings of higher mental health problems among bisexual individuals compared to their monosexual counterparts (Feinstein & Dyar, 2017), and unique stressors in bisexual individuals may have led to more pronounced physical health conditions. However, gay men were more affected than bisexual men by chronic kidney diseases, cancer, and hepatitis B/C, possibly due to their higher prevalence of HIV-related comorbidities: Hepatitis B/C and particularly cancer are known as HIV-related comorbidities (Casper et al., 2017; Gallant et al., 2017) and HIV tends to be highest in gay men (Cochran & Mays, 2007; Han et al., 2020; Operario et al., 2015).

3.7.3. Strengths, Limitations, and Implications for Future Research

Strengths, limitations, and implications for future research are presented together for both the women's and the men's reviews. The biggest strength of Studies I and II is that, to the best of our knowledge, these are the most comprehensive systematic reviews and meta-analyses on physical health conditions in lesbian-, gay-, and bisexual-identified individuals compared to

their heterosexual counterparts. Our detailed search string and use of five databases likely captured the vast majority of relevant studies. Additionally, we requested data from authors to ensure the most accurate primary data possible. Furthermore, we are aware that disease classifications are inherently somewhat arbitrary. However, by using the GBD classification from globally recognized institutions like the WHO and Harvard University, we relied on a well-established and widely accepted framework. Moreover, most of the included samples rely on large, representative health surveys, which provide a solid database. The sampling weights used in most studies increase the probability of a racially and ethnically diverse sample, not an almost completely white sample. There are also several limitations to consider. To retain comprehensive information, our systematic review included both weighted and unweighted data, though this approach may slightly reduce comparability. For the most representative statistical summaries, however, only weighted data were used in our meta-analyses. Additionally, most comparisons relied solely on self-reports. One study comparing self-reported and examination-based diagnoses revealed discrepancies, suggesting that sexual minority individuals, often facing barriers to healthcare, may be underdiagnosed and may report fewer conditions (Caceres et al., 2018). Furthermore, the review focused solely on gay, bisexual, and heterosexual individuals, excluding pansexual, queer, or asexual individuals. Thus, it does not fully represent the diversity of sexual minority groups at risk for health disparities. Lastly, the majority of studies were conducted in the USA, with only a few from other countries in the Global North. Therefore, the generalizability of our findings is primarily limited to these regions of the world.

We found significant heterogeneity in meta-analyses across subgroups, emphasizing the importance of subgroup-specific analysis. Therefore, this review underscores the need for further research on various subgroups. Is HIV a primary contributor to higher prevalence of certain physical health conditions among gay men? Why are bisexual individuals at elevated risk for stress-related conditions like asthma? We also advocate for investigating why respiratory health is disproportionately affected compared to other physical systems. Studies on hypertension and diabetes highlight the need for nuanced data collection, such as separating data on pregnancy-related conditions in women. Furthermore, longitudinal studies are essential for clarifying whether minority stress or other factors are predominant causes for

the physical health disparities. Moreover, exploring how different dimensions of sexual orientation (e.g., attraction/behavior) are associated with health outcomes is crucial for comparisons of the different dimensions of sexual orientation and their link to physical health disparities. Additionally, more data on pansexual, asexual, and queer individuals would be desirable.

3.8. CONCLUSION

The systematic reviews and meta-analyses on both women and men found physical health disparities by sexual identity. The vast majority of these disparities were to the detriment of sexual minority individuals. The findings underscore the need for routinely incorporating sexual identity assessment into health research. By obtaining a more comprehensive understanding and by considering non-heterosexual identity as a potential risk factor for specific diseases, we can address disparities more effectively and ensure optimal healthcare.

CHAPTER 4 – SUMMARY OF STUDY III: ONLINE-SURVEY ON MINORITY STRESS AND HEALTH IN LESBIAN, GAY, AND BISEXUAL INDIVIDUALS

4.1. GENERAL INFORMATION

STUDY III

Haarmann, L., Dennert, G., Folkerts, A.K., Träuble, B., Kalbe, E. (submitted). Key Role of Psychopathological Stress Responses in explaining how Intersectional Minority Stress affects Physical Health: Results from a German cross-sectional Online-Survey in Lesbian-, Gay- and Bisexual-identified Individuals.

The third study, the online-survey in Lesbian-, Gay- and Bisexual-identified Individuals manuscript was submitted to the *Journal of Homosexuality* on 3rd May, 2024.

4.2. SCIENTIFIC CONTRIBUTIONS

The study was a collaboration with the Department of Applied Social Sciences, University of Applied Sciences and Arts Dortmund, Germany (head: Gabriele Dennert). The project was supervised by Elke Kalbe at each step of the work. Gabriele Dennert gave advice during the process. **Lena Haarmann**, Gabriele Dennert, Ann-Kristin Folkerts, Birgit Träuble, and Elke Kalbe conceptualized the study design. **Lena Haarmann** and Ann-Kristin Folkerts collected the data. **Lena Haarmann** conceptualized and conducted the data analysis. **Lena Haarmann** and Elke Kalbe interpreted the results. **Lena Haarmann** drafted the first version of the manuscript. All authors revised the manuscript for intellectual content and approved the final version of the manuscript. **Lena Haarmann** and Elke Kalbe led the submission process.

4.3. INTRODUCTION

Previous research indicates that sexual minority individuals experience poorer physical health compared to heterosexual individuals: Lesbian, gay, and bisexual (LGB) adults typically rate

their own health lower and report a higher number of acute physical symptoms and chronic health conditions compared to heterosexual adults (Fredriksen-Goldsen, Emlet, et al., 2013; Frost et al., 2015; Haarmann et al., 2023; Haarmann et al., 2024). When analysing health disparities in sexual minority individuals, 'minority stress' is often discussed as a key explanatory factor. Yet, its role as a primary cause of poorer physical health in sexual minority individuals and its exact mechanisms on well-being are still being explored. Lick et al. (2013) propose a theoretical framework suggesting that minority stress, mediated by psychological and physiological responses, affects health behaviours and influences health status. Further empirical testing of these pathways is encouraged by the authors (Lick et al., 2013). This study expands upon Lick's conceptual framework (Lick et al., 2013), empirically investigating the influence of intersectional minority stress on the health of sexual minority individuals and exploring underlying mechanisms, as many associations within the model have not been collectively tested previously. One SEM study with related concepts showed that marginalization in older LGBT adults (≥ 50 years) negatively affects physical health, mediated by mental health and health-promoting behaviour (Fredriksen-Goldsen, Kim, Shui, et al., 2017). We focus on the psychological aspect of Lick's model (2013), specifically concentrating on psychopathological stress responses and resilience as potential mediators. Furthermore, as another mediating variable, health literacy (positioned in the health norms/belief in health behaviour in Lick's model) will be included. For a detailed elaboration on what is already known about the respective relationships among these main study variables and their association with physical health, please refer to the original manuscript.

4.4. OBJECTIVES

The objectives of this study were to test whether the experience of intersectional minority stress manifests in poorer physical health, mediated by psychopathological stress responses, resilience and health literacy. The specific hypotheses of this study were defined as follows:

H1: Minority stress has a negative total effect on physical health. The effect is mediated by psychopathological stress responses (H1a) and resilience (H1b).

H2: Psychopathological stress responses have a negative total effect on physical health. The effect is mediated by health literacy (H2a).

H3: Resilience has a positive total effect on physical health. The effect is mediated by health literacy (H3a).

Note: A visual representation of the hypotheses can be found in the figure of the hypothesized SEM model in the included manuscript (Chapter: Original Publications and Manuscript).

4.5. METHODS

Study design & participants

The hypotheses were tested in an online-survey via the open-source tool SoSciSurvey (Leiner, 2019). The weblink generated by SoSciSurvey was distributed via LGBTIQ organizations, groups, mailing lists and social media platforms, both digitally and analogously via printed postcard-flyers (Figure 6). Inclusion criteria were: (i) identifying as lesbian, gay, or bisexual; (ii) ≥18 years of age; (iii) primary residence in Germany; and (iv) sufficient proficiency in German to understand and respond to the questionnaires. The study was preregistered in the German Register of Clinical Studies (DRKS00023658) and received a positive vote from the Ethics Committee of the University Hospital Cologne (20-1730). The data collection was pseudonymized. Alongside questions on sociodemographic variables, surveys incorporated assessments of intersectional minority stress, psychopathological stress responses, resilience, health literacy, and physical health.

Statistical analysis

The proposed structural relationships (hypotheses 1–3) were analysed using SEM in AMOS V.29. Standard Model fit characteristics were applied as psychometric literature has proposed that models demonstrate reasonable fits, if $\chi 2/df$ is <3.0 (Hair et al., 2009; Iacobucci, 2010; Kline, 2004). RMSEA is <.08 (Awang, 2012), CFI >.90, SMSR <.08, AGFI>.90 (Byrne, 1994), and IFI is >.90 (Meyers et al., 2005). Total, direct, and indirect effects were determined through bootstrapping with 5,000 replications and the mediation analysis followed the classification proposed by Zhao et al. (2010) after critiquing the prevailing approach of Baron and Kenny

(Baron & Kenny, 1986; Zhao et al., 2010). An 'Analytics Calculator' was used to predetermine the required minimum sample size: It yielded a minimum number of at least *N* = 288 participants (Soper, 2023). Significance was set at $\alpha < .05$ for all parameters.

Figure 6.

Postcard-Flyer for Recruitment of Participants (Front and Back of Postcard)

UNIKLINIK KÖLN

Medizinische Psychologie
Neuropsychologie & Gender Studies

Online-Studie an der Uniklinik Köln zu Diskriminierungserfahrungen und Gesundheit ...

... bei Menschen, die sich als lesbisch, schwul oder bisexuell identifizieren. Wenn Ihr Euch angesprochen fühlt, würden wir uns sehr freuen, wenn Ihr mitmacht. Zur Studie, weiteren Infos und Kontaktdaten gelangt Ihr über den QR-Code oder indem Ihr die folgende Seite aufruft:

http://soscisurvey.de/MinStress_Health/

Die Daten werden pseudonymisiert erhoben und es dauert etwa 20–30 Minuten, den Fragebogen auszufüllen. Wir danken ausdrücklich jeder Person, die bereit ist, Ihre Erfahrungen mit uns zu teilen! Wir freuen uns, wenn Ihr auch andere Menschen auf die Studie aufmerksam macht!

Herzlichen Dank im Namen des gesamten Studienteams!

P2206024

© TitelMotiv: ADragan - iStockphoto.com

love is free

Jetzt mitmachen!

An alle Menschen, die sich als lesbisch, schwul oder bisexuell identifizieren (all genders, ab 18)

4.6. RESULTS

Sample characteristics

After applying the inclusion criteria for the main analysis, 521 participants remained in the final total sample. Among them, 237 identified as lesbian women, 88 as bisexual women, 171 as gay men, and 25 as bisexual men. The mean age of the final sample was 39.37 (*SD* = 13.02, age range: 18–78 years). Overall, 94.8% identified as cisgender, while 5.2% identified as non-cisgender. The average education level was high, with about two-thirds of the participants holding A-levels.

Model fit (SEM)

Before assessing the fit of the structural equation model, we confirmed a good fit of the measurement model. Cronbach's α surpassed .70 for all constructs, indicating a good internal consistency and reliability (Field, 2013). Furthermore, factor loadings were high, exceeding .50 for almost all variables (Field, 2013). The hypothesized structural equation model reached acceptable model fit (χ^2/df = 2.749; RMSEA = .058 [90% CI: .051, .065]; CFI = .940; SRMR = .056; AGFI = .906; IFI=.940) according to the cut-offs for model fit reported in the method section.

Total effects

Regarding the total effects, the data supported hypotheses H1–H3: (H1) Minority stress had a negative total effect on physical health (β =-.22, p <.001), and (H2) psychopathological stress responses had a negative total effect on physical health (β =-.86, p <.005), while (H3) resilience had a positive total effect on physical health (β =.41, p <.001).

Mediation analysis

Hypothesis 1a and b. The indirect effect of minority stress (MS) on physical health (PH) was significant via psychopathological stress responses (PSR) (β =-.26, p <.001, MS $\rightarrow$ PSR $\rightarrow$ PH), as was the direct effect (β =.16, p <.05). However, the indirect effect via resilience (R) was not significant (β =.03, p =.26, MS $\rightarrow$ R $\rightarrow$ PH). Thus, the negative total effect of minority stress on physical health was mediated by psychopathological stress responses (but not resilience), supporting H1a (but not H1b). Following Zhao et al. (2010), this mediation was classified as a 'competitive mediation', with psychopathological stress responses acting as a suppressor

variable: Minority stress significantly heightened psychopathological stress responses, which in turn very strongly decreased physical health. Additionally, the indirect effect via resilience and psychological stress responses was also significant (β =-.17, p <.001, MS → R → PSR → PH). Therefore, resilience made a contribution to explaining the indirect effect of minority stress on physical health, but only when psychopathological stress responses were part of the equation. In summary, psychopathological stress responses primarily drove the negative impact of minority stress on physical health.

Hypothesis 2a. The indirect effect of psychopathological stress responses on physical health was not significant (β =.01, p =.34). Thus, the total effect of psychopathological stress responses on physical health (H2) was not mediated by health literacy. Consequently, H2a was not supported as the relationship was direct only, with a substantial direct effect of β =-.86, p <.005.

Hypothesis 3a. The indirect effect of resilience on physical health via health literacy (HL) was not significant (β = -.01, p = .27, R → HL → PH), and there was also no significant direct effect of resilience on physical health (β = -.09, p = .29). Consequently, H3a was not supported, as the positive total effect of resilience on physical health was not mediated by health literacy.

4.7. DISCUSSION

4.7.1. Discussion of Main Findings

The study aimed to provide empirical data on the effects of intersectional minority stress on the health of sexual minority individuals and to analyse underlying mechanisms. Overall, intersectional minority stress was found to have a negative total effect on physical health, mediated by psychopathological stress responses, but not by resilience. Nevertheless, resilience significantly contributed to the mediation by buffering the psychopathological stress responses. Furthermore, psychopathological stress responses had a direct negative, and resilience a positive indirect effect on physical health and overall, health literacy did not contribute substantially to any of these effects.

Previous studies have highlighted the harmful effects of discrimination and minority stress on mental health (Hoy-Ellis, 2023; Lick et al., 2013; Meyer, 2003), as well as the interconnectedness of mental and physical health (Cohen et al., 2007; Miller & Chen, 2010). This study bridged these associations by demonstrating that psychopathological stress responses mediate the relationship between minority stress and physical health within a single comprehensive model. Our findings align with previous research, such as studies on older LGBT adults and young Israelis, highlighting the negative impact of minority stress on physical health through mental health pathways (Fredriksen-Goldsen, Kim, Bryan, et al., 2017; Shilo & Mor, 2014). In our model, we observed a significant indirect effect of intersectional minority stress on physical health, primarily mediated by psychopathological stress responses. Thus, our study provides support for aspects of Lick's conceptual framework (Lick et al., 2013) and extends previous work by incorporating an intersectional perspective and emphasizing resilience as a crucial factor promoting health.

4.7.2. Strengths, Limitations, and Implications for Future Research

The strengths of our study are that we provided initial empirical support for some of the pathways outlined by Lick et al. (2013) within one comprehensive model, while considering multiple intersecting factors shaping unique experiences of social inequality. Our study extended previous research across a wide age range, incorporating an intersectional perspective and resilience as a key health-promoting factor. Despite potential sampling bias, online-surveys enable reaching diverse, hard-to-reach populations. Therefore, using an online-survey led to a relatively large sample, which is another strength of our study. However, there are also a few limitations to consider: One major limitation is the study’s reliance on cross-sectional data, limiting the ability to establish definitive causality. Long-term data are necessary to address reverse causation adequately. While the theoretical framework aligns with previous empirical findings, only longitudinal studies can conclusively rule out reverse causation. Additionally, distributing the questionnaire via LGBTIQ organizations introduces sampling bias, making the sample unrepresentative. Individuals affiliated with supportive organizations may differ from those unaffiliated, potentially impacting the study’s outcomes. Furthermore, the

sample's relatively homogenous composition, with only 6–7% likely to have experienced racism, restricts the generalizability to LGB individuals who are Black or BIPoC.

Longitudinal studies, especially those commencing early in the lives of young LGBTIQ individuals, offer a means to address limitations inherent to cross-sectional designs as addressed before. Future research should also focus on developing and evaluating interventions to strengthen resilience among sexual minority individuals, as well as exploring effective strategies for reducing minority stress and discrimination in the first place.

4.8. CONCLUSION

In line with Lick's framework, we confirmed a negative total effect of intersectional minority stress on physical health. This effect was mainly mediated by psychopathological stress responses, highlighting their role in explaining health impacts from discrimination. While health literacy had minimal impact, resilience contributed to the mediation by buffering the psychopathological stress responses. Longitudinal studies are needed to validate these findings, and further research is necessary to develop interventions that reduce minority stress and enhance resilience in sexual minority individuals.

CHAPTER 5 – GENERAL DISCUSSION

5.1. MAIN FINDINGS

The overarching aims of the present thesis project were: (I) analysing the status quo of physical health in sexual minority individuals (compared to the majority group of heterosexual individuals) and (II) contributing to uncovering underlying mechanisms leading to physical health disparities for sexual minority individuals. Understanding the current state of health disparities and exploring the mechanisms behind them is essential for creating a discrimination-free society where the health of minority groups is indistinguishable from that of the majority.

In this general discussion on the main findings of this thesis, I will focus on six major findings that have been identified with regard to the research questions and the hypotheses of the thesis outlined in Chapter 2. The first four main findings from Studies I and II (systematic reviews) address the question of whether there are differences in prevalence of physical health conditions in sexual minority individuals compared to heterosexual individuals. I will summarize these differences and discuss potential explanatory factors, embedding the results within the broader context of previous research and the introduction of this thesis.

Research Question I: What is the status quo of physical health among sexual minority individuals? Specifically, does the prevalence of physical health conditions differ between

(a) lesbian- and bisexual-identified women compared to heterosexual-identified women?

(b) gay- and bisexual-identified men compared to heterosexual-identified men?

Finding 1: For both women and men, the most notable differences in prevalence by sexual identity were observed in chronic respiratory conditions, particularly asthma, with a higher prevalence in sexual minority individuals.

In both systematic reviews, in both women and men, results on chronic respiratory conditions and particularly asthma were the most consistent of all conditions included in the reviews. Regarding women, our results are in line with two previous reviews of smaller scopes that

indicated higher prevalence of asthma in sexual minority women compared to heterosexual women as well (Eliason, 2014; Meads et al., 2018). Regarding men, to the best of my knowledge, our systematic review was the first to demonstrate that sexual minority men have significantly higher prevalence rates of asthma compared to heterosexual men. Concerning asthma, across approximately 20 studies involving women and 15 studies involving men, not a single study indicated a significantly lower prevalence among sexual minority individuals. An overwhelming majority found a higher prevalence in sexual minority individuals, most of them with significant results. Meta-analyses on asthma confirmed the findings: overall, differences in prevalence were larger in women than in men, and larger for bisexual- vs. heterosexual- than lesbian-/gay- vs. heterosexual-identified individuals (ORs: 2.28 for bisexual-identified women, 1.62 for bisexual-identified men, 1.51 for lesbian-identified women, 1.43 for gay-identified men). Studies that aggregated chronic respiratory conditions into one joint category (including e.g., asthma, chronic bronchitis, or COPD) revealed similar patterns for both women and men. One exception was studies on COPD, which showed nearly no significant differences.

What could be the reasons for these overall distinct differences by sexual identity regarding chronic respiratory conditions and particularly asthma?

It is known that the global prevalence of asthma ranges from 1% to 18%, varying by region (Global Asthma Network, 2022). In the USA and Europe, it is approximately 5% to 10% (Global Asthma Network, 2022). Asthma has a mixed age structure and can affect people of all ages (Mirabelli et al., 2013). Environmental risk factors, such as exposure to allergens, air pollution, tobacco smoke, and certain occupational conditions, play a significant role in asthma development (Asthma and Allergy Foundation of America, 2024). Moreover, it is increasingly recognized that stress significantly contributes to both the onset and exacerbation of asthma (Hayes, 2023).

In particular, previous research suggests that psychosocial stress plays an important role in impacting asthma: It has been reported before that interpersonal stress, such as divorce and separation from significant others, is associated with asthma (Lietzen et al., 2011). Furthermore, research has emphasized the significant impact of targeted rejection, a distinct stressor involving intentional social exclusion, on asthma compared to other stressors such as non-interpersonal and interpersonal stress (Murphy et al., 2015). In a study of 121 youths with

asthma, targeted rejection emerged as a strong predictor of changes in gene expression and symptom severity. Those who experienced targeted rejection exhibited lower expression of key signalling molecules controlling airway inflammation, particularly the glucocorticoid receptor and β2-adrenergic receptor (Murphy et al., 2015). The authors of the study concluded that "threats to the social self may be particularly deleterious" (Murphy et al., 2015). Given the close relationship between discrimination and targeted rejection, this study could help to shed light on the elevated prevalence of asthma in sexual minority individuals.

In line with this argument, additional studies on other marginalized groups at risk of discrimination have demonstrated increased asthma severity following experiences of discrimination as well. For instance, a study on self-reported racial/ethnic discrimination and bronchodilator response in African American youth with asthma revealed that those reporting discrimination had a higher mean percent bronchodilator response compared to those who did not report discrimination (Carlson et al., 2017). Bronchodilator response is a commonly used measure of asthma severity and is frequently used in asthma diagnosis (Carlson et al., 2017). Similarly, another study found that African American children reporting any form of discrimination had an almost 80% higher risk of experiencing asthma (Thakur et al., 2017).

A previous meta-analytic review concluded that discrimination impacts mental and physical health directly and indirectly through heightened stress responses and participation in unhealthy behaviours (Pascoe & Smart Richman, 2009). In the context of asthma, two factors stand out regarding the indirect influence of discrimination on poorer physical health: *smoking* and *environmental factors*. Smoking, more prevalent among sexual minorities than heterosexuals (Fredriksen-Goldsen, Kim, et al., 2013; Job et al., 2023), may exacerbate respiratory conditions due to discrimination. For example, a representative study revealed that minority stressors independently increased the likelihood of smoking among U.S. sexual minority adults (Gordon et al., 2021). Another systematic review of tobacco disparities among sexual minorities pinpointed unique risk factors for smoking, such as internalized homophobia and responses to sexual orientation disclosure (Blosnich et al., 2013). Regarding environmental factors, a cross-sectional study revealed that respiratory risk from hazardous air pollutants was nearly 25% greater for same-sex partners compared to heterosexual partners (Collins et al., 2017). The authors of the study argue that this difference is likely due to sexual minority

individuals' higher likelihood of residing in inner-city neighbourhoods where there is more severe air pollution (Collins et al., 2017).

Overall, we found it remarkable that the results were very similar for both women and men, with asthma being the condition showing the most significant differences in both our systematic reviews. This suggests that a non-heterosexual identity should be considered a risk factor for asthma and other chronic respiratory conditions, regardless of gender.

Finding 2: Beyond asthma and chronic respiratory conditions, a higher prevalence in sexual minority individuals was found regarding a number of further health conditions.

In addition to asthma and chronic respiratory conditions, higher prevalence was found among sexual minority individuals for several other health conditions including acne, back pain, headache disorders, hepatitis B/C, oral disorders, and urinary tract infections in women, as well as headache disorders, hepatitis B/C, and chronic kidney diseases in men.

In both women and men, a higher prevalence of hepatitis B/C was found in sexual minority individuals. Gay men and bisexual women had the highest odds of suffering from hepatitis, with these odds ratios among the highest in both reviews. Lesbian women did not have elevated odds compared to heterosexual women. What gay and bisexual men, as well as bisexual women, have in common—and what distinguishes them from lesbian women—is that they potentially have sex with men who have sex with men. Men who have sex with men are more prone to be HIV positive (Cochran & Mays, 2007; Han et al., 2020; Operario et al., 2015), and since hepatitis is a common comorbidity with HIV (Gallant et al., 2017), this could explain the higher hepatitis prevalence in gay men, bisexual men, and bisexual women, but not lesbian women. Since hepatitis B and C can be sexually transmitted, they may spread through this route (Inoue & Tanaka, 2016; Singh et al., 2000).

While this systematic review examined general physical health conditions and omitted sexually transmitted diseases, it is crucial to acknowledge HIV as a prevalent health concern among sexual minority men. Considering its significant implications for comorbidities, HIV must be integrated into discussions concerning general health conditions, while being sensitive towards potential stigmatization of gay men as well. HIV could also have contributed to the

higher odds of gay men having chronic kidney diseases, as chronic kidney diseases are a comorbidity of HIV as well (Gupta et al., 2005). However, bisexual men did not have elevated odds for chronic kidney diseases. But since gay men are most likely to have HIV—also when compared to bisexual men (Cochran & Mays, 2007; Han et al., 2020; Operario et al., 2015)—HIV could still be one of the explanatory factors.

Another physical health condition with higher prevalence in sexual minority individuals in both women and men were headache disorders/migraines. As described in the context of the first major finding (*Finding 1*), psychosocial stress could be one of the main reasons for the higher asthma prevalence in sexual minority individuals. Targeted rejection specifically has been associated with higher asthma rates before (Murphy et al., 2015). Targeted rejection can be considered a distal stressor of minority stress within the framework of discrimination. The heightened prevalence of headache disorders/migraines among sexual minority women and men may be attributed to similar underlying mechanisms. Previous research has shown that lower perceived social status, including self-rated standing in the community, is associated with an increased likelihood of migraines in women in general (Hammond & Stinchcombe, 2019). Lesbian, gay and bisexual individuals may perceive their social status as lower as well, which might lead to an increase in the risk of suffering from headaches and migraines. Similar to asthma, the probability of experiencing headaches or migraines appears to increase in response to adverse life circumstances (Burch et al., 2019; Martin, 2016). One of the studies included in the analysis found that severe mental illness contributed, at least in part, to the heightened prevalence of severe headaches and migraines among sexual minority individuals (Heslin, 2020). This finding lends empirical support to Lick and colleagues' minority stress model, which suggests that psychopathology (psychological stress responses) acts as a mediating factor in the link between minority status and physical health disparities (Lick et al., 2013). It also corresponds with *Finding 6* of this thesis, indicating that psychopathological stress responses mediate the effect of intersectional minority stress on physical health, as discussed further down below.

In relation to the increased prevalence of back pain among sexual minority women, heightened (minority) stress could also have been an explanatory factor. For lower back pain, psychosocial risk factors such as harassment, discrimination (Yang et al., 2023), social isolation,

social conflicts, and perceived long-term stress (Puschmann et al., 2020) have been identified as relevant. However, the question remains why elevated odds ratios have been observed for sexual minority women but not for sexual minority men. One possible explanation could be the intersectionality of identities: sexual minority women may experience discrimination and stress not only based on their sexual identity, but also due to their gender and due to the interplay of both dimensions. This compounded marginalization can amplify the impact of minority stress on physical health outcomes like back pain. This aligns with results from *Finding 1*, showing higher asthma rates in sexual minority women than in sexual minority men, on average.

Furthermore, sexual minority women also exhibited higher prevalence rates for acne, oral disorders, and urinary tract infections. However, these findings warrant careful interpretation due to their reliance on one single study each. Concerning acne, prior research indicates elevated mean testosterone levels in sexual minority women compared to heterosexual counterparts (Harris et al., 2020; Macdowall et al., 2022), potentially contributing to the increased incidence of acne among lesbians. Yet, it is important to note that a systematic review on sex hormone levels in lesbian, bisexual and heterosexual women found insufficient data to definitively establish differences in hormone levels by sexual identity (Harris et al., 2020).

More research is needed to understand both minority stress and other possible influencing factors (e.g., comorbidities of HIV, potentially varying hormone levels, differing health behaviors) and their impact on physical health disparities (see also implications for future research).

Finding 3: A lower prevalence was found regarding pregnancy-related conditions and cancer in sexual minority women. No lower prevalence was found in sexual minority men.

While no overall lower prevalence of any conditions was found for sexual minority men, for sexual minority women, we observed a lower prevalence of diabetes (in bisexual women and SMW) and hypertension (for all sexual minority women) as compared to heterosexual-identified women, as well as lower prevalence rates of cancer in bisexual-identified compared to heterosexual-identified women.

In relation to *Findings 1* and *2*, it was discussed how increased stress might contribute to the higher prevalence of the physical health conditions listed in these findings among sexual minority individuals. Since diabetes and hypertension are also known as stress-related illnesses, the question arises why an opposite pattern was identified for these conditions, showing that sexual minority women have a lower risk of developing diabetes or hypertension. A deeper, more detailed look into the data provided some insights into how this result might have arisen. We believe that higher pregnancy rates among heterosexual-identified women compared to sexual minority women could have contributed to the higher overall prevalence rates of diabetes in heterosexual-identified women. Previous research has shown that sexual minority women report fewer pregnancies. Specifically, one meta-analysis revealed that pregnancy is nearly 90% less likely for lesbian women, and 50% less likely for bisexual women as compared to heterosexual women (Hodson et al., 2017). Additionally, it is known that up to one in every ten women (nearly 10%) develops gestational diabetes during pregnancy (Centers for Disease Control and Prevention, 2022). Of these women suffering from gestational diabetes, up to 50% subsequently develop diabetes type 2 (Centers for Disease Control and Prevention, 2022). In conclusion, women who have ever been pregnant, have a higher overall risk of diabetes than those who have never been pregnant, which is more likely for sexual minority women. The results of three studies included in the review support this argument: these studies excluded gestational diabetes (as well as prediabetes) from their analysis, and across those three studies, prevalence rates were about equally balanced for women of all sexual identities (Beach et al., 2018; Dilley et al., 2010; Fredriksen-Goldsen, Kim, et al., 2013).

Hypertension is even more prevalent during pregnancy, affecting up to 13% of all pregnant women (Dunietz et al., 2017; Ford, 2022). There was one study included in our review that gathered data on hypertension both during and outside of pregnancy: This study revealed that heterosexual-identified women had a significantly higher prevalence of hypertension during pregnancy (McNair et al., 2011). In contrast, for lesbian women, the odds ratios for hypertension outside of pregnancy were 1.5 times higher, though this difference was not significant (McNair et al., 2011). Yet, the previously observed discrepancy regarding higher prevalence among heterosexual-identified women disappeared. However, it is crucial to note these findings on hypertension stem from one study only, and further research distinguishing

between conditions during and outside pregnancies could yield clearer insights (see also implications).

Apart from lower prevalence of diabetes and hypertension in sexual minority women, another result that caused attention was that bisexual-identified women had lower cancer rates than heterosexual-identified women. For cancer diagnosis, the median age is 66 years (Morgan, 2020). Similarly, this applies to diabetes and hypertension, as these conditions are most commonly diagnosed between the ages of 50 and 60 years (Helmer, 2022; Johns Hopkins Medicine, 2022). Therefore, the latter mentioned diseases have a significantly different typical onset age compared to asthma, for which the largest disparities to the detriment of sexual minorities have been found. Asthma can emerge at any age, commonly diagnosed as early as in childhood, adolescence, or young adulthood (Mirabelli et al., 2013). Similarly, other stress-induced conditions like headaches and migraines typically first affect individuals in early adulthood (Mayoclinic, 2022). Older sexual minority adults are particularly challenging to reach and may be underrepresented in studies, potentially introducing bias, especially in diseases with age-related incidence. Therefore, the risk of bias might be increased for diseases whose likelihood rises with age, such as cancer. Notably, studies that examined cancer prevalence only in older adults (≥50 years) found that cancer prevalence was actually higher in sexual minority women than in heterosexual women, though this difference was not significant (Brown et al., 2015; Han et al., 2020). Differences in average age of onset may explain more pronounced disparities in some diseases compared to others, especially in unweighted samples and (A)ORs not adjusted for age. For more details, please refer to the results and discussion on the comparisons of ORs and AORs in the original publication of the systematic review on women.

Finding 4: Two trends could be observed: Regarding some of the stress-related conditions, 1) bisexual-identified individuals tended to be more affected than lesbian-, and gay-identified individuals, and 2) women tended to be more affected than men.

Across categories, we identified a trend of bisexual individuals being more affected by some of the stress-related conditions than lesbian or gay individuals, respectively. For bisexual women, this was the case for asthma, headache disorders, and back pain. This trend was also observed

for bisexual men, though to a lesser extent and only for asthma and headache disorders, but not for back pain.

In their analysis of bisexuality, minority stress, and health, Feinstein and Dyar (2017) demonstrate how research consistently reveals higher rates of mental health problems among bisexual individuals compared to their monosexual (heterosexual, lesbian, gay) counterparts (Brennan et al., 2010; Conron et al., 2010; Jorm et al., 2002; Semlyen et al., 2016). For instance, it has been shown that bisexual women and men were over four times more likely to consider suicide than monosexual individuals (Conron et al., 2010). Despite the shared risk of discrimination and hostility faced by all sexual minority individuals, bisexual individuals encounter unique stressors that can intensify their challenges (Feinstein & Dyar, 2017). They regularly face negative attitudes from multiple sources: Both heterosexual and gay/lesbian individuals may hold resentments towards them, such as questioning the legitimacy of bisexuality and refusing intimate relationships with bisexual individuals (Feinstein & Dyar, 2017). This phenomenon, referred to as 'binegativity,' can complicate the search for safe spaces where one feels fully accepted for bisexual individuals (Feinstein & Dyar, 2017). This difficulty could contribute to a heightened minority stress experienced by bisexual individuals, potentially leading to an increased prevalence of physical health issues, as evidenced in this systematic review regarding stress-related conditions.

The fact that the differences were greater to the detriment of bisexual *women* than bisexual *men* could be rooted in intersectional discrimination experiences and corresponds with the second trend found within the scope of the two systematic reviews: Women belonging to sexual minorities had higher prevalence rates than men belonging to sexual minorities. Particularly regarding the stress-related conditions like asthma, headache disorders, and back pain, a very consistent pattern emerged: The overwhelming majority of studies, with very few exceptions, showed higher prevalence rates for sexual minority women compared to sexual minority men. This could be attributed to the fact that sexual minority women are not only prone to experiencing discrimination based on their *sexual identity* but also based on their *gender*, i.e., from the intertwining of these two dimensions and the specific experiences that result from this intersection. Moreover, a higher prevalence of the mentioned stress-related conditions could also be inferred from the comparison of heterosexual women and

heterosexual men as well, indicating that women in general have higher rates than men. This underscores the argument of potential intersectional discrimination experiences faced by sexual minority women compared to sexual minority men.

To sum up, what do these results imply regarding the hypotheses that were postulated in the beginning with regard to Research Question I?

HIa: There is a higher prevalence of physical health conditions in lesbian- and bisexual-identified women compared to heterosexual-identified women.

HIb: There is a higher prevalence of physical health conditions in gay- and bisexual-identified men compared to heterosexual-identified men.

In summary, the hypotheses HIa and HIb were largely confirmed: with very few exceptions (lower cancer rates in bisexual women and a lower prevalence of pregnancy-related conditions), there was an equally high prevalence, or a higher prevalence, of many physical health conditions in lesbian- and bisexual-identified women compared to heterosexual-identified women (HIa). Regarding men, gay- and bisexual-identified men experienced physical health conditions at prevalence rates that were at least comparable to, and often exceeded, those observed in heterosexual men (HIb).

The last two findings, from Study III, will be discussed in relation to the second research question: whether intersectional minority stress negatively affects physical health and whether psychological factors mediate this effect, with reference to existing research.

Research Question II: Is there a negative total effect of intersectional minority stress on the physical health of lesbian-, gay-, and bisexual-identified individuals? Is the effect mediated by psychopathological stress responses, resilience, and health literary?

Finding 5: There was a negative total effect of intersectional minority stress on the physical health of lesbian-, gay-, and bisexual-identified individuals.

The first main result from the online-survey was that there was a negative total effect of intersectional minority stress on the physical health of lesbian-, gay-, and bisexual-identified individuals. As outlined in the introduction of this thesis, elevated minority stress, such as discrimination, rejection, and internal homophobia, has been linked to higher incidences of chronic diseases and poorer overall health before (Frost et al., 2015). LGB adolescents facing frequent homophobic remarks have been found to suffer more from headaches (Woodford et al., 2012), and older LGB adults experiencing lifelong victimization and financial barriers to healthcare have been shown to report poorer general health and daily functioning disabilities (Fredriksen-Goldsen, Emlet, et al., 2013). A previous systematic review found that minority stress impacts various biological functions, including inflammation, immune and cardiovascular function, and metabolic and endocrine systems (Flentje et al., 2020). Notably, studies included in the review have shown that acute minority stressors cause immediate blood cell count changes and respiratory infections (Cole et al., 1996; Hengge et al., 2003). Hence, our results are in line with results from previous research. Additionally, we could expand those previous findings by introducing an intersectional dimension: Our questions on minority stress were designed to capture the full range of a person's discrimination experiences, rather than limiting them to those based on sexual identity (for more details, please refer to the original manuscript).

Furthermore, we could show that the negative total effect of intersectional minority stress on physical health in one joint structural equation model, including psychological factors that mediated the total effect, as described in the next and last major finding (*Finding 6*) of this thesis.

Finding 6: The total effect of intersectional minority stress on physical health was mediated by psychological factors, primarily by psychopathological stress responses, which were mitigated by resilience.

The total effect of intersectional minority stress on physical health was mediated by the three psychological factors (psychopathological stress responses, resilience and health literacy) to different degrees: the psychopathological stress responses were the main drivers for the

significant mediation effect, while resilience and health literacy were not significant mediators individually. However, resilience significantly contributed to the mediation by buffering the psychopathological stress responses. Health literacy did not contribute to the mediation.

The findings underscore the crucial role of psychopathological stress responses resulting from discrimination: Intersectional minority stress increases mental health problems, such as heightened symptoms of anxiety and depression, which subsequently affect physical health negatively. Previous studies have shown the harmful effects of discrimination and minority stress on mental health (Hoy-Ellis, 2023; Lick et al., 2013; Meyer, 2003), and the link between mental and physical health has also been established (Cohen et al., 2007; Miller & Chen, 2010). In our study, we could connect these two established findings by demonstrating that psychopathological stress responses mediate the relationship between minority stress and physical health in one conjoint model. Therefore, we could provide initial evidence for some of the pathways postulated in the theoretical model by Lick et al. (2013). As far as I know, these factors have not been studied together in one complex model before. However, related concepts have been analysed and those largely align with the results found in our study: In older LGBT adults (≥ 50 years), marginalization has been demonstrated to have adverse effects on physical health, with mental health and health-promoting behaviour serving as mediating factors (Fredriksen-Goldsen, Kim, Bryan, et al., 2017). Similarly, among young Israelis (aged 12–30), heightened levels of minority stressors coupled with limited coping resources were predictive of diminished mental health, subsequently correlating with poorer physical health outcomes (Shilo & Mor, 2014).

Resilience, even though not confirmed as a significant single mediator, still significantly contributed to the mediation by diminishing the psychopathological stress responses: High resilience levels reduced the psychopathological stress responses, indirectly impacting physical health through this mitigation. Yet, it is essential to highlight that the indirect influence of resilience on physical health was significant only when psychopathological stress responses were considered in the equation. Based on these findings, it might be valuable to consider including resilience as a moderator variable in future studies using SEM.

In contrast to resilience, and particularly to the psychopathological stress responses, health literacy did not play a role in explaining physical health. Contrary to previous studies in

the general population (Berkman et al., 2011; Schaeffer et al., 2017), we did not observe the effect of high health literacy levels significantly improving physical health in the present sample.

Zhao et al. (2010) provide a classification of mediation analysis, including a flowchart for categorizing mediation and non-mediation types and their implications for theory building. According to this classification, the significant mediation that was found in our study (psychopathological stress responses mediating the negative total effect of minority stress on physical health) was classified as a 'competitive mediation'. When following Zhao et al. (2010) this means that the "mediator identified [is] consistent with hypothesized theoretical framework. But [the authors] should consider the likelihood of an omitted mediator in the 'direct' path" (Zhao et al., 2010, p. 201). In the case of the present study, this means that evidence for the mediator 'psychopathological stress responses' has been found. Yet, the likelihood of another mediator should be considered. Another mediator that could be added to the SEM of our study could be 'health behaviours'. A previous meta-analytic review on perceived discrimination and health across diverse minoritized populations (including but not limited to sexual minorities) found that discrimination is both directly and indirectly associated with mental and physical health issues, mediated by increased stress responses *and* more participation in unhealthy behaviours and less participation in healthy behaviours (Pascoe & Smart Richman, 2009). Furthermore, research has shown that sexual minority individuals are more likely to show disadvantageous health behaviours such as higher rates of smoking and drinking (Fredriksen-Goldsen, Kim, et al., 2013) as well as exercising less (Fredriksen-Goldsen, Emlet, et al., 2013). Additionally, one of the studies on related concepts also found that health behaviours were one of the significant mediators of the negative effect of marginalization on physical health (Fredriksen-Goldsen, Kim, Bryan, et al., 2017).

Overall, psychopathological stress responses—alongside health behaviours—should be one main focus, when analysing mechanisms of mediation between minority stress and physical health in more detail in the future.

Summing up, what do these results imply regarding the hypothesis that was postulated in the beginning with regard to Research Question II?

HII: There is a negative total effect of intersectional minority stress on the physical health of lesbian-, gay-, and bisexual-identified individuals, mediated by psychopathological stress responses, resilience, and health literacy.

The second hypothesis (HII) was largely confirmed as well: There was a negative total effect of intersectional minority stress on the physical health of lesbian-, gay-, and bisexual-identified individuals, and it was mediated by psychological factors. However, regarding the impact of the three tested psychological factors (psychopathological stress responses, resilience, and health literacy), large differences were identified: The psychopathological stress responses had the greatest impact on the mediation, with resilience contributing by mitigating these responses. Health literacy had no significant impact on the mediation.

For a final summary, the research questions, hypotheses, and the major findings of the thesis are presented in Table 1.

Table 1.

Overview of Research Questions, Hypotheses, and Main Findings of the Thesis

Research Question I	What is the status quo of physical health among sexual minority individuals? Specifically, does the prevalence of physical health conditions differ between (a) lesbian- and bisexual-identified women compared to heterosexual-identified women? (b) gay- and bisexual-identified men compared to heterosexual-identified men?
Hypothesis I	HIa: There is a higher prevalence of physical health conditions in lesbian- and bisexual-identified women compared to heterosexual-identified women. HIb: There is a higher prevalence of physical health conditions in gay- and bisexual-identified men compared to heterosexual-identified men.
Finding 1	*For both women and men, the most notable differences in prevalence by sexual identity were observed in chronic respiratory conditions, particularly asthma, with a higher prevalence in sexual minority individuals.*

Finding 2	*Beyond asthma and chronic respiratory conditions, a higher prevalence in sexual minority individuals was found regarding a number of further health conditions.*
Finding 3	*A lower prevalence was found regarding pregnancy-related conditions and cancer in sexual minority women. No lower prevalence was found in sexual minority men.*
Finding 4	*Two trends could be observed: Regarding some of the stress-related conditions, 1) bisexual-identified individuals tended to be more affected than lesbian-, and gay-identified individuals, and 2) women tended to be more affected than men.*
Research Question II	Is there a negative total effect of intersectional minority stress on the physical health of lesbian-, gay-, and bisexual-identified individuals? Is the effect mediated by psychopathological stress responses, resilience, and health literary?
Hypothesis II	HII: There is a negative effect of intersectional minority stress on the physical health of lesbian-, gay-, and bisexual-identified individuals, mediated by psychopathological stress responses, resilience, and health literacy.
Finding 5	*There was a negative total effect of intersectional minority stress on the physical health of lesbian-, gay-, and bisexual-identified individuals.*
Finding 6	*The total effect of intersectional minority stress on physical health was primarily mediated by psychopathological stress responses, which were mitigated by resilience. Health literacy did not contribute to the mediation.*

5.2. GENERAL STRENGTHS AND LIMITATIONS

A notable strength of this thesis is its choice of topic: While research on health among sexual minority individuals is gradually becoming established in the Anglo-American world, especially in the USA, with dedicated institutes and professorships, this is not yet the case in Germany or Europe, where such research is still rare or sporadic. However, previous research (Eliason, 2014; Meads et al., 2018; Simoni et al., 2017), as well as the results of this thesis, indicate that considerable health disparities exist and that research in this field is both necessary and important.

There are also some strengths related to the two main projects (systematic reviews and online-surveys) comprising the empirical part of this thesis. One noteworthy strength is that, to my knowledge, the status quo of physical health among sexual minority adults compared to heterosexual adults has not been previously captured as comprehensively as in this thesis. Peer-reviewers of the reviews' publications also acknowledged that the scope of the reviews was a 'mammoth piece of work'. Another strength of the review is its meticulous methodological approach: the database search was conducted by trained information specialists; a very large number of studies (23,000+) were screened; primary data from numerous authors was requested; the review relied on a classification released by globally renowned health institutions (WHO, Harvard University); and reporting followed the PRISMA guidelines for systematic reviews and meta-analyses (Moher et al., 2009). Furthermore, in order to maximize our systematic approach, we focused on one of the dimensions of sexual orientation—sexual identity—thereby enhancing the precision of our findings. Overall, to the best of my knowledge, the systematic reviews for both women and men represent the most extensive compilation of existing research results on physical health conditions among sexual minority individuals compared to heterosexual individuals. Physical health disparities by sexual identity have not been comprehensively demonstrated elsewhere as they have in this thesis, which I consider a key strength.

One further strength is that, in addition to comprehensively portraying the status quo, this thesis also attempted to provide some insight into the mechanisms that contribute to this status quo, conducted through the online-survey. A notable strength of the online-survey was its large sample size (500+ participants in the final sample), ensuring that the empirical results of this thesis rely on a solid database. Within the survey, we could also provide initial evidence for some of the pathways that were theorized by Lick et al. (2013). Moreover, we incorporated an intersectional perspective regarding the experiences of minority stress, and we also added a salutogenic aspect (resilience). Hence, the holistic approach of both the stressors and stress theory, encompassing both beneficial and detrimental health processes, can be considered another strength of this thesis.

There are also several limitations to this thesis. One of the main limitations is that the online-survey relies on a cross-sectional rather than a longitudinal design. While the analyses

are based on solid theoretical frameworks and models as proposed by Meyer (1995; 2003) and Lick (2013), the cross-sectional design limits identification to associations rather than causal relationships. This is particularly relevant in the context of mediation analysis, which is best examined through longitudinal studies, underscoring the necessity for future longitudinal studies to validate the findings of the online-survey (see also implications for future research).

In addition, there are limitations regarding the generalizability of the results: First, all reported findings, both from the reviews and the empirical study, originate from countries from the Global North. Regarding the reviews, this is due to the fact that although searches were conducted in international databases, the studies meeting the inclusion criteria almost exclusively derived from Anglo-American countries. Regarding the empirical study, language and ethical restrictions limited data collection to participants from Germany. Second, the generalizability is restricted to lesbian, gay and bisexual individuals and not to all sexual minority individuals. The rationale behind this selection has been laid out in the introduction of this thesis (e.g., data on most other sexual identities is too limited for systematic reviews, and theoretical frameworks predominantly focus on LGB individuals). Another limitation to generalizability arises from the online-survey's relatively homogenous sample, where only about 6–7% were likely to have experienced racism, potentially restricting the findings' applicability to Black/BIPoC LGB individuals. Research suggests that racism, especially in healthcare, can prompt individuals to avoid seeking medical help, leading to serious health repercussions (Ateş et al., 2023). For more details on the limitations of the studies (Study I–III), please refer to the single publications.

One last limitation affecting all studies involving minority groups is the risk of reproducing stereotypes by simply naming and repeating them, and by emphasizing power imbalances when subordinating minority groups to a majority group. Furthermore, the use of the term 'minority' itself can be viewed critically, as it may imply a sense of subordination due to the root 'minor'. Therefore, it is important to emphasize that here it strictly refers to numerical minorities. An example of repeating stereotypes can be seen in discussions on 'binegativity'. By elaborating on and explaining these stereotypes, there is a risk that readers may either learn new stereotypes or reinforce existing ones through repeated exposure. Nevertheless, highlighting issues and naming the status quo remain necessary to address

imbalances and ultimately achieve equality, as without this, changes may not occur and health disparities may persist.

5.3. IMPLICATIONS AND FUTURE DIRECTIONS

5.3.1. Implications for Future Research

The thesis' findings imply some future research directions that will be discussed in the following sections. Regarding the results from the systematic reviews and meta-analyses, several research ideas could and should be addressed and pursued. The reviews focused on physical health conditions, relying on diagnoses reported by the participants of the included studies. Previous research has indicated that sexual minority individuals may have limited healthcare access (Dahlhamer et al., 2016) and may avoid healthcare due to previous discrimination (Ayhan et al., 2020), resulting in fewer interactions with healthcare providers. Since diagnoses require interactions, it can be inferred that sexual minorities are more likely to be underdiagnosed. This means that querying diagnoses may underestimate or obscure the actual situation. Diagnoses, as objective classifications of diseases, only partially capture their true impact on daily life. Thus, a diagnosis may not always align with personal suffering, and suffering may occur without a diagnosis. Therefore, we are currently conducting two additional reviews on a comparison of 'subjective overall health indicators' irrespective of diagnoses to supplement the findings of the current reviews and advocate for considering subjective reports of well-being besides diagnoses. This approach also aligns with the broader definition from the WHO, which defines health "as a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity", as mentioned in the introduction (World Health Organization, 2024a).

One of the main findings from the reviews (*Finding 1*) revealed that both women and men showed significantly higher prevalence rates of chronic respiratory conditions, particularly asthma, among sexual minority individuals. As discussed, previous studies suggest that interpersonal stress (Lietzen et al., 2011), particularly intentional social exclusion (Murphy et al., 2015), is strongly associated with asthma. However, most research has focused on other populations rather than specifically on sexual minority individuals. Therefore, future studies

should analyse whether these mechanisms apply to the population group of sexual minority individuals as well. Additionally, future research should focus on understanding why discrimination and social exclusion may particularly affect the lungs or the respiratory system as a whole as compared to other organs or physiological systems. The same applies to conditions like back pain and headaches, as they are also stress-related disorders with higher prevalence rates for sexual minority individuals (*Finding 2*). Thus, future studies should aim to examine specific forms of stress and their respective impacts on particular organs or physiological systems in more detail.

Further research is needed to understand both minority stress and other potential influencing factors and their impact on physical health disparities in more detail. Some of these other potential factors, discussed in the respective conditions section of the main findings, include comorbidities of HIV, environmental factors (e.g., higher exposure to air pollution from living in more urban areas), potentially varying hormone levels (e.g., higher mean testosterone levels in SMW), and differences in health behaviors (e.g., higher rates of drinking and smoking). Investigating the contribution of these factors to the physical health disparities found in the two reviews is crucial for future research.

The findings regarding pregnancy-related conditions (partly lower prevalence in sexual minority compared to heterosexual women, *Finding 3*), underscore the importance of capturing diverse realities of life. It is essential to consider and acknowledge that certain conditions are more common in individuals who have ever been pregnant than in those who have never been pregnant. Therefore, future large representative health studies should follow the example of some of the studies included in the review (Beach et al., 2018; Dilley et al., 2010; Fredriksen-Goldsen, Kim, et al., 2013; McNair et al., 2011) and differentiate between pregnancy-related and pregnancy-unrelated diagnoses to account for the differences in pregnancy rates by sexual identity.

With regard to the increased prevalence of some of the stress-related conditions among bisexual individuals compared to monosexual individuals (*Finding 4*), 'binegativity' has been discussed as a possible cause. Future studies should examine whether this hypothesis withstands empirical testing and/or if alternative factors offer greater explanatory power. Besides minority stress from 'binegativity', alternative factors potentially resulting in physical

health disparities could include hormone levels, as well as environmental, socio-economic, and behavioral factors. These factors should also be considered and investigated. Furthermore, it is essential to explore subgroup differences within sexual minority individuals, not only comparing bisexual to lesbian/gay individuals, but also examining other subgroups like pansexual or asexual individuals in greater depth. Beyond the differences between bisexual and monosexual individuals, a trend was identified showing that women, particularly lesbian and especially bisexual women, were significantly more affected by some of the stress-related diseases than men. This could be related to intersectional discrimination experiences, as previously discussed. Thus, future studies, both regarding the status quo and underlying mechanisms, should incorporate intersectional perspectives considering factors such as gender identity (beyond a binary understanding), ethnicity, and socioeconomic status, which are potentially interacting as well. Different dimensions along which power dynamics manifest and operate should be considered intersectionally to create a more nuanced understanding. Besides intersectional minority stress as one potential factor, it is relevant for future research to test alternative models to further elucidate the observed differences between findings from the reviews of women's and men's health. What are the distinctions between sexual minority women and men, and how do these differences manifest in higher prevalence rates among women compared to men? For example, do hormone levels or health behaviors differ and potentially result in physical health differences between genders?

The systematic reviews in this thesis concentrated on one dimension of sexual orientation, namely identity, to maximize precision. Previous studies have highlighted identity as the dimension most strongly associated with discrimination (Geary et al., 2018). However, it's important to note that individuals with same-sex attraction/behaviour may also face discrimination (Geary et al., 2018), suggesting the need for systematic reviews on attraction and behaviour as well. Such additional reviews would also allow for comparisons to identify which dimensions of sexual orientation are most strongly linked to which health conditions.

One major limitation of this thesis addressed in the previous section is the cross-sectional design of the online-survey. Future studies should adopt a longitudinal design to validate the findings (*Finding 5* and *6*) and to provide more insights into causal relationships. Ideally, these studies should begin at a young age, preferably during the coming-out or queer

awakening phase of young queer people in order to track how mediating factors, such as psychopathological stress responses and resilience, develop and interact over time. These longitudinal studies can deepen our understanding of how discrimination and minority stress manifest in the physical health of sexual minority individuals. Hence, we're currently planning a new longitudinal study to follow young queer individuals over approximately two years. Based on prior research indicating the potential role of health behaviour, various forms of health-related behaviour should be incorporated as additional mediators in future studies as well. Moreover, in the more distant future, multidisciplinary approaches could be of interest, incorporating not only psychological but also physiological stress responses and their interplay, ideally in long-term analyses as well. Exploring physiological differences more broadly could also contribute to a detailed understanding of physical health disparities.

In terms of applied research, the focus should be on finding and evaluating effective strategies for reducing discrimination and minority stress, which should be viewed as a societal issue requiring exploration from political and social science perspectives as well. Simultaneously, from a psychological standpoint, research should focus on strategies to enhance resilience among queer individuals. This thesis found evidence suggesting that resilience can mitigate psychopathological stress responses, thereby positively impacting mental and physical health. Since community connectedness was a component of resilience in our study, it is crucial to investigate how queer individuals can effectively connect with queer communities to maximize the benefits of this protective factor. This particularly includes vulnerable subgroups, such as queer older adults and those living in rural areas with less queer 'infrastructure' than urban regions.

5.3.2. Implications for Practice

Reducing minority stress and discrimination should not only be of scientific interest but also has to be of major interest for other societal players, organizations and institutions. Creating a discrimination-sensitive society, not just regarding sexual identity but across all dimensions that risk creating unequal power dynamics, must be understood as a collective societal responsibility. To make societies more sensitive to discrimination, several measures can be

implemented. These include educational programs in schools, such as workshops and anti-bullying initiatives, and diversity and inclusion training for companies, including unconscious bias workshops and mentoring programs. Supporting research on discrimination and health disparities, creating networks between institutions, and providing psychological and legal assistance to victims are further steps that can help raise awareness, reduce minority stress, and build a more inclusive society.

From a practical standpoint, it would be desirable for healthcare professionals to enhance their awareness of risk factors related to discrimination and diversity for specific conditions. Physical health disparities exist, and awareness should be raised among healthcare providers regarding these disparities. With regard to more specific measures or actions for the healthcare system, implementing diversity and inclusion trainings for medical staff can also be beneficial. Particularly, workshops on unconscious bias could help to recognize and reduce discriminatory behaviours. These workshops should also include knowledge of physical health conditions that showed the highest risks for disparities, such as asthma, back pain, and headache disorders. Furthermore, guidelines distributed to healthcare providers on diversity-sensitive care are a practical and resource-efficient measure as well. Ideally, training for medical personnel and healthcare providers on both health disparities and physical health risks due to discrimination should be routinely integrated earlier into both academic curricula and healthcare vocational training programs. In practice, medical history forms should include dimensions of diversity, like sexual identity. Providing information on these dimensions should be voluntary for patients to prevent exposing individuals and potentially placing them in a more vulnerable position. However, routinely incorporating these dimensions should be the future approach in healthcare to identify and address heightened vulnerabilities, particularly concerning stress-related conditions. Collecting this information routinely can help to shape a detailed and nuanced picture of health disparities, which is essential for addressing them.

Another approach is to strengthen the resilience of queer individuals, for instance, by expanding queer-specific services and resources, particularly for vulnerable groups such as older queer individuals, queer BIPoC, and those living in rural areas. Enhancing community connectedness for as many queer people as possible increases resilience and can mitigate negative health outcomes. It is also vital to expand dedicated queer-sensitive healthcare

services and ensure visibility of these services, providing queer individuals with reliable information on where to access appropriate care. This can help to rebuild trust and increase the utilization of healthcare services, such as organizations like Every Health* and Queermed (Every Health*, 2024; Queermed, 2024).

In general, the same principle applies to all practical measures and implications for future research: the overarching goals should be to detect and minimize health disparities, and reduce discrimination and its potential health consequences for all members of society.

5.4. GENERAL CONCLUSION

In summary, the present thesis provided a comprehensive systematic overview on the status quo of the physical health of lesbian-, gay-, and bisexual-identified individuals compared to heterosexual-identified individuals. We found evidence of physical health disparities by sexual identity, primarily to the detriment of sexual minority individuals. Specifically, higher prevalence rates of chronic respiratory conditions, notably asthma, were observed among sexual minority adults compared to heterosexual adults. Furthermore, sexual minority adults also experienced higher prevalence rates of some stress-related conditions, like headache disorders and back pain, and also, for instance, hepatitis B/C. Overall, except for rare exceptions like pregnancy-related conditions and cancer in women, sexual minority adults consistently experience at least equal, and in many cases greater, vulnerability to various health conditions across all physical health categories. In addition to analysing the status quo of physical health conditions and identifying health disparities, this thesis attempted to uncover mechanisms contributing to these health disparities. Here, supporting Lick's theoretical framework, evidence for a negative total effect of intersectional minority stress on physical health was found. This total effect was mainly mediated by psychopathological stress responses which played a key role in revealing how minority stress manifests in physical health. Resilience also played an important role by mitigating the psychopathological stress responses and thus indirectly buffered detrimental effects to the physical health of sexual minority individuals. Future research should aim to validate these findings in longitudinal studies. To mitigate health risks stemming from discrimination, democratic societies must scientifically evaluate strategies

to reduce minority stress and discrimination. Additionally, studies should prioritize the development and evaluation of interventions that enhance resilience, as this protective factor can buffer negative physical health outcomes in sexual minority individuals, as observed in this thesis. Furthermore, it is relevant to analyse and minimize factors that contribute to physical health disparities, including minority stress, as well as alternative explanations such as environmental, behavioural, and other factors. All future studies in this field should ultimately aim to advance the overarching goal of achieving a society where the health of minority group members is indistinguishable from that of the majority, fostering true equality for all individuals.

EPILOGUE

The preface at the beginning of this thesis concluded with the questions: Are there physical health disparities in sexual minority individuals compared to heterosexual individuals? Do experiences of discrimination or the fear thereof affect queer peoples' health?

Results from this thesis tend to suggest that the short answer to these questions is yes. And this even applies to countries of the Global North, which is the area this work can address. This even applies to these countries of the Global North, where queer people experience varying degrees of discrimination and minority stress. Yet, these queer people are much less frequently attacked, criminalized, and punished compared to queer people in parts of the world that are less queer-friendly or even punish queer people by law. What then must it mean for people like Ugandan activist Ssenfuka Joanita Warry, whose quote on the import of homophobia to Africa since British colonial times still resonates with me? What impact must her experiences have on her physical and mental well-being? What does it mean in terms of physical health disparities in countries of the Global South? Are they comparable to the disparities in countries of the Global North, or do they differ?

During the development of this work, Ssenfuka Joanita Warry faced the following: the lesbian and women's rights organization she leads, Freedom and Roam Uganda, received an eviction notice (FlüchtlingsRAT NRW e.V., 2023; Schneider, 2023). She says: "We had been in that building for 15 years. Now our landlord has terminated the lease out of fear of the new law." According to the new law enacted in March 2023 in Uganda, up to 20 years in prison can be imposed for 'promotion of homosexuality', which includes renting premises to LGBTIQ individuals. Ssenfuka Joanita Warry states: "The law has set us back 20 years […] We now have to work in hiding again, just like in my early days as an activist" (Schneider, 2023).

What must this renewed criminalization mean for her health and her well-being? How does this daily existential threat manifest in her body? And what does it mean in terms of health disparities in countries like Uganda or other countries that punish queer people by law?

As much as I value my work and this field of research, I hope that one day it will become obsolete because the oppression of queer people will no longer exist.

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ORIGINAL PUBLICATIONS AND MANUSCRIPT

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STUDY II

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STUDY III

Full manuscript title: Key Role of Psychopathological Stress Responses in explaining how Intersectional Minority Stress affects Physical Health: Results from a German Cross-Sectional Online-Survey in Lesbian-, Gay- and Bisexual-identified Individuals

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Abstract

The minority stress concept, initially proposed by Meyer (1995), was later expanded by Lick et al. (2013): Their theoretical framework suggests that minority stress impacts physical health in lesbian-, gay-, and bisexual-identified (LGB) individuals mediated by different pathways, including psychological factors. However, empirical testing is lacking and encouraged by Lick et al. (2013). Therefore, our objective was to test whether experiencing intersectional minority stress in LGB individuals manifests in poorer physical health, mediated by psychopathological stress responses, resilience, and health literacy. A cross-sectional online-survey was conducted in a sample (*N*=521) of German LGB adults (≥18 years) between 02.2022-02.2023. For total effects and mediation analysis, Structural Equation Modeling (SEM) in AMOS V.29 was applied. The SEM reached acceptable model fit (χ^2/df=2.749; RMSEA=.058; CFI=.940) and results aligned with main study hypotheses: Intersectional minority stress had a negative total effect on physical health, mediated by psychopathological stress responses, but not resilience. However, resilience significantly contributed to the mediation by buffering the stress responses. Psychopathological stress responses had a negative direct and resilience a positive direct effect on physical health. No effect was mediated by health literacy. In summary, we found evidence for some of the pathways postulated by Lick et al. (2013).

Key words: minority stress, LGB health, psychopathological stress responses, resilience, structural equation model

Introduction

Previous research has shown that sexual minority individuals report poorer physical health compared to heterosexual individuals: Lesbian, gay and bisexual (LGB) adults tend to rate their own health lower (Fredriksen-Goldsen, Emlet, et al., 2013; Frost et al., 2015) and suffer from a higher number of acute physical symptoms and chronic health conditions compared to heterosexual adults (Haarmann et al., 2023; Haarmann et al., 2024).

When exploring potential explanatory factors for these health disparities, the concept "minority stress" is often discussed. Yet, its role as the primary cause of poorer physical health in sexual minority individuals and its exact mechanisms on well-being are still being explored. In this context, Lick et al. (2013) have introduced a conceptual framework, proposing that minority stress, mediated by psychological and physiological stress responses, impacts health behaviors and, ultimately influences an individual's health status. The authors encourage further empirical testing of these potential pathways. This study extends Lick's conceptual framework (Lick et al., 2013), by empirically examining the impact of intersectional minority stress on the health of sexual minority individuals and exploring underlying mechanisms. Many associations within the model have not been tested collectively before. There is one structural equation modeling study with related concepts, demonstrating that marginalization in older LGBT adults (≥50 years) negatively impacts physical health mediated by mental health and health-promoting behavior (Fredriksen-Goldsen, Kim, Bryan, et al., 2017).

We focus on the psychological aspect of Lick's model (2013), specifically concentrating on *psychopathological stress responses* and *resilience* as potential mediators. Furthermore, as another mediating variable, *health literacy* (as part of health norms/belief in health behavior in Lick's Model) will be included. In the following section, we will introduce minority stress alongside with the potential mediators (psychopathological stress responses, resilience and health literacy) elaborating on what is already known about the respective relationships among these variables and also on their associations with physical health.

Minority Stress

Minority stress was first introduced by Meyer (1995) and refers to unique stressors and challenges faced by individuals that are part of marginalized groups, such as sexual minority individuals. Minority stress theory states that experiencing stigma, or even the fear of experiencing stigma, triggers feelings of distress that can have profound consequences for the personal well-being (Meyer, 2003). Within this framework, minority stress is understood as the accumulation of distal and proximal stressors across the lifespan, that can overwhelm a person's coping strategies and in the long run affect physical health and well-being negatively (Lick et al., 2013). Distal stressors are *external* events that cause psychological distress, like victimization and stigma, while proximal stressors are *internal* conflicts triggered by experiences of victimization and stigma, like anticipation of rejection (Meyer, 2003). There are indications that minority stress affects physical health negatively: For instance, frequent exposure to minority stress has been linked to more headaches and a higher number of chronic physical diseases and worse overall physical health (Frost et al., 2015).

Minority stress can affect people for multiple reasons, often simultaneously on more than one dimension: Crenshaw (1989) coined the term "intersectionality" to illustrate how racism and sexism interact and create specific forms of marginalization in lives of Black women. The concept has subsequently been expanded to better understand the interdependence of various social inequalities, e. g. addressing also sexual orientation or socioeconomic position alongside sex/gender and race.

"Intersectionality" emphasizes that these factors don't add up linearly but interact in complex ways, possibly influencing various aspects of a person's life, including health. Although aspects of interacting dimensions of social inequality have been discussed since the late 1970s, particularly in women's studies (Schneider et al., 2019), its representation in many areas of health research remains insufficient. Nancy Krieger, as one of the pioneers in intersectional health research, and Olena Hankivsky, as one of the current experts in this field, both advocate for including intersectional frameworks in health research (Hankivsky, 2012; Krieger, 2019).

In the present study, Lick's model will be expanded by using an intersectional approach for minority stress assessment (see measurements), including discriminatory experiences based not only on sexual orientation, but also cultural or ethnic background, racism, history of

migration, religion, gender identity, gender biography, disabilities or chronic illnesses, social status, and age.

Psychopathological Stress Responses

Psychopathological stress responses refer to abnormal or disordered reactions to stressors, which are external events or situations that elicit a demand for adjustment or adaptation. Psychopathological stress responses may manifest as various mental health symptoms or disorders, such as anxiety and depression (Christopher, 2004; Kaluza, 2023). In Meyer's initial definition of minority stress, it is explicitly anchored that minority stress triggers distress (Meyer, 2003) and empirical evidence further supports this link (Hoy-Ellis, 2023). Previous studies indicate that gay men exposed to higher levels of minority stress are three times more prone to experiencing symptoms of psychological distress, such as anxiety, hopelessness as one of the main symptoms of depression, and lower self-esteem, compared to those facing lower levels of minority stress (Meyer, 1995). Furthermore, frequent exposure to distal stressors is linked to psychological distress including depressive symptoms and suicide attempts (Hatzenbuehler, 2011; Lick et al., 2013).

Regarding physical health, there are numerous reports across various populations associating heightened stress responses to negative physical health outcomes, such as immune system dysfunction (Miller & Chen, 2010), increased vulnerability to colds, the flu, and headaches (Cohen et al., 1991), as well as increased vulnerability to heart diseases and cancer (Cohen et al., 2007). Notably, a U.S. study demonstrated that the heightened distress that is experienced by sexual minority compared to heterosexual individuals, accounted for some of the physical health disparities observed between gay and heterosexual men, as well as most of the disparities between lesbian and heterosexual women (Cochran & Mays, 2007).

Resilience

Resilience refers to an individual's capacity to endure, thrive and progress amidst adversity and challenges (Meyer, 2015). The capacity encompasses all factors that contribute to a positive

adaptation to (minority) stress, and, thus, mitigate the potential negative effects of stress on health (Meyer, 2015). Hereby, it is crucial to emphasize that resilience is not contradictory or antithetical to stress theories; instead, it is understood as a pivotal aspect *of* stress theory: According to stress theory, the impact of stress on health is determined by the opposing effects of pathogenic stress processes (like psychopathological stress responses) and salutogenic processes (like resilience) (Meyer, 2015). Likewise, within the framework of minority stress theory, the significance of resilience becomes apparent, particularly in the actual presence of minority stress, thereby playing a crucial role in comprehending the health implications of minority stress (Meyer, 2015). Thus, resilience can function as a suppressor, when a (minority) stressor activates resilience as a "buffer". For instance, a physical and/or verbal attack on an LGB individual can activate increased support from their community, thus, mitigating potential health detriments. This instance also exemplifies the rationale behind Meyer's distinction between individual resilience and community resilience. While individual resilience refers to attributes that enhance an individual's capacity for effective agency, such as sense of coherence, locus of control, or fatalism, community resilience refers to how communities contribute in expanding the individual's capacities to develop and maintain well-being and health. Thus, resilience on community level is reinforced by the individuals' perception of being able to overcome adversity and challenges, *because* of their connection to the community (Meyer, 2015). By incorporating resilience into Lick's model, we introduce a crucial resource-oriented component, aiming to account for the opposing effects of pathogenic stress processes and salutogenic processes as posited in stress theory.

Health Literacy

Over the years, the concept health literacy has evolved beyond basic mathematical and linguistic skills in medical contexts to include empowerment aspects like successful communication and navigation in complex health systems (Van den Broucke, 2014). An international team of experts developed a comprehensive model, that defines health literacy as "the knowledge, motivation and competences to access, understand, appraise and apply health information in order to make judgments and take decisions in everyday life concerning health care, disease prevention and health promotion to maintain or improve quality of life

throughout the course of life" (Sørensen et al., 2012). Despite criticism for its subjective nature (assessment of this approach is self-rated), the approach is widely cited in literature, likely due to its positive association with objective health outcomes (Berkman et al., 2011; Schaeffer et al., 2017), suggesting that subjective health literacy manifests in a person's health.

Gerich and Moosbrugger (2018) examined factors influencing subjective health literacy to understand high or low health literacy scores. They found that higher scores were associated with strong personal resources (like self-efficacy or coping skills) or high trust in healthcare professionals. Consequently, they concluded that subjective health literacy reflects the perceived "manageability" of health-related tasks: individuals must either trust themselves to handle these tasks or trust healthcare experts to navigate them (Gerich & Moosbrugger, 2018). A systematic review found that sexual minority adults frequently avoid seeking healthcare due to concerns about discrimination (Ayhan et al., 2020). As a result, one can assume that, on average, sexual minority individuals have lower trust in healthcare professionals compared to heterosexual individuals. As psychopathological stress responses are characterized by feelings of hopelessness and low self-efficacy, hence low manageability, we expect them to negatively impact health literacy. Whereas, we expect resilience, characterized by high personal capacities, hence high manageability, to have a positive effect on health literacy.

In summary, building on the framework of Lick et al. (2013), the aim of this study is to test, whether the experience of intersectional minority stress manifests in poorer physical health, mediated by psychopathological stress responses, resilience, and health literacy. Specifically, the hypotheses (see also Figure 1) are defined as follows:

H1: Minority stress has a negative total effect on physical health.

The effect is mediated by psychopathological stress responses (H1a) and resilience (H1b).

H2: Psychopathological stress responses have a negative total effect on physical health.

The effect is mediated by health literacy (H2a).

H3: Resilience has a positive total effect on physical health.

The effect is mediated by health literacy (H3a).

Materials and Methods

Study design and participants

In order to test the hypotheses, an online-survey was conducted using SoSciSurvey, a free and open-source tool for creating and conducting online-surveys (Leiner, 2019). After implementing all the required questionnaires (see measurements), SoSciSurvey generates a weblink for participants to start the survey. The survey was pretested in the target population of lesbian-gay- or bisexual-identified adults (*N*=10) for clarity and use of sensitive and appropriate language, resulting in a few minor wording adaptations. Subsequently, alongside study details and informed consent, the weblink was distributed via LGBTIQ organizations, associations, mailing lists and social media. Inclusion criteria were (i) identifying as lesbian, gay, or bisexual, (ii) ≥18 years of age, (iii) primary residence in Germany, and iv) sufficient proficiency in German to understand and respond to the questionnaires. The study was preregistered in the German Register of Clinical Studies (DRKS00023658) and was positively evaluated by the Ethics Committee of the University Hospital Cologne (20-1730). When starting the survey, participants were informed about the study's purpose and data protection policies. Data were collected pseudonymously using a unique 8-digit code generated from participants' responses to six questions (e.g., first and last letter of the birthplace). This ensured secure pseudonymized data storage. If a participant later wished to revoke consent, they could contact the study team to delete their data using the assigned code. To initiate participation, it was required to explicitly check a box indicating consent to take part. In addition to sociodemographic questions, surveys included measures that assessed minority stress, psychopathological stress responses, resilience, health literacy, and physical health. On average, completing the questionnaire took approximately 25 minutes.

Measurements

The five latent variables "*minority stress*", "*psychopathological stress responses*", "*resilience*", "*health literacy*", and "*physical health*" are represented by several indicators each. For all indicator variables, higher scores indicate higher levels of the respective variable.

Minority Stress

The Daily Heterosexist Experience Questionnaire (DHEQ) is designed to measure *minority stress* among lesbian, gay, bisexual and transgender (LGBT) individuals (Balsam et al., 2013). The questionnaire consists of 50 items categorizable into nine subscales addressing everyday experiences related to minority stress. The authors highlight that, depending on the context, utilizing specific subscales might be more practical than using the entire questionnaire. Hence, certain subscales less pertinent to the target population, like 'gender expression' or 'parenting,' were not included. In this online-survey four subscales of the DHEQ were applied: harassment and discrimination (MS1), vicarious trauma (MS2), vigilance (MS4) and family of origin (MS5) (Figure 1). To account for intersectionality, the subscales "harassment and discrimination" and "vicarious trauma" were adjusted. For example, the question "*I have been stared at in public because I am LGBT*" was revised to "*I have been stared at in public*". The phrase "because I am LGBT" was similarly omitted from the other items. Omitting this part highlights that victims of discrimination are not responsible for understanding the reasons for discrimination and furthermore allows for the possibility of multiple (simultaneous) reasons for discrimination. The two subscales "family of origin" and "vigilance" were applied in their translated original versions as they address relationship aspects, eliminating the need for explicit intersectional modifications (e.g., item of subscale family of origin: "*My family has avoided talking about my LGBT identity"*; vigilance: "*I have avoided talking about my current or past relationships when I am at work*").

Another indicator variable for *minority stress* originated from the LGBT Minority Stress Measure (Outland, 2016). This scale consists of 25 items assigned to seven subscales. Considering 'rejection anticipation' as a relevant concept not covered by the DHEQ, we incorporated this aspect from the LGBT Minority Stress Measure. Thus, the subscale used here is the translated version of the subscale rejection anticipation (MS3) (e.g., *"I braced myself to*

be treated disrespectfully, (because I am LGBT"). Following the same intersectional approach, the phrase "because I am LGBT" was omitted for the respective items, too. As a sixth indicator variable for *minority stress,* a self-generated tool on sexualized and physical violence (MS6) was used, which had been previously applied in a discrimination survey at the University of Applied Sciences and Arts Dortmund, Germany (Dennert, 2020).

Items on all indicator variables of *minority stress* were rated on a 6-point Likert scale ranging from 0= "*Did not happen/not applicable* to me" to 5= "*It happened and it bothered me extremely*" as recommended by the DHEQ. Results are mean scores per subscales. Cognizant of sensitivity and based on pretest findings, we introduced filter questions, including instructions and the option to skip, before addressing some of the minority stress questions, notably those related to family of origin and sexualized and physical violence. This yielded two total mean scores for *minority stress*: one with four subscales and another with one with all six. The questionnaire on minority stress is provided in Supplement A.

Psychopathological stress responses

Two indicator variables were used for the latent variable *psychopathological stress responses*: level of anxiety symptoms and depressive symptoms.

The Beck's Anxiety Inventory (BAI) is a self-assessment tool designed to measure anxiety levels (Beck et al., 1988). It contains 21 descriptive statements on anxiety symptoms, categorized into physiological, cognitive, and physiological-cognitive combined aspects of anxiety. Respondents rate their experiences on a 4-point Likert scale (0 = *"not at all"* to 3 = *"severely – I could hardly bear it"*), with a total score range from 0-63.

The Patient Health Questionnaire (PHQ-9) is a self-assessment instrument to screen for depressive symptoms (Kroenke et al., 2001). It provides indications for evaluating the severity of depressive symptoms. Participants are asked to report how often they were bothered by nine symptoms (e.g., *"feeling down, depressed, or hopeless"*). Items are rated on a 4-point Likert scale ranging from 0= *"not at all"* to 3= *"nearly every day"*) with a total score ranging from 0-27.

Resilience

As previously stated, we adopted Meyer's suggestion (Meyer, 2015) to define resilience in sexual minority individuals as a combination of individual and community resilience. Individual resilience is assessed via the validated German version of the Resilience-13 scale (Leppert et al., 2008). It consists of the two subscales personal competency (9 items, e.g., *I feel that I can handle many things at once*, RS1) and acceptance (4 items, e.g., *I like myself,* RS2), and is rated on a 7-point Likert scale ranging from totally agree to totally disagree (Leppert et al., 2008).

To assess community-level resilience, the subscale "Community Connectedness" (CC) of the aforementioned LGBT Minority Stress Measure was used (Outland, 2016). The subscale consists of 5 items that assess one's connection to the LGBT community (e.g., *I feel like I am a part of the LGBT community*). Here, the original (translated) items – and not modified items – were applied, as the explicit focus is on the affiliation with the LGBT community. Items are rated on a 5-point Likert scale, ranging from 1= *"strongly disagree"* to 5= *"strongly agree".* Results are mean scores.

The two RS-13 subscales (R1, R2) and the Community-Connectedness-Scale (CC) are indicators for the latent variable *resilience*.

Health Literacy

The European Health Literacy Questionnaire Short Version (HLS-Q-EU-16) was used to assess health literacy (Sørensen et al., 2015). The HLS-Q-EU-16 is the short version of the HLS-Q-EU-47; it comprises sixteen questions measuring the perceived difficulty of health-related tasks. Participants rate the 16 items on a 4-point Likert scale: *very easy, fairly easy, fairly difficult*, and *very difficult*. The scale consists of three subscales: health care (HL1), disease prevention (HL2), and health promotion (HL3), as defined by the expert consortium mentioned above (Sørensen et al., 2015). Indices per subscale are standardized using a formula to maintain comparability, with values ranging from 0-50 (Sørensen et al., 2015). The three subindices constitute the indicator variables (HL1-3) for the latent variable *health literacy*.

Physical Health

For the assessment of physical health, the Short Form 36 Health Survey (SF-36) was applied. It is a widely used self-report questionnaire on overall health status and health-related quality of life (Bullinger, 1995). The SF-36 can be applied broadly, since it is not specific to any particular disease or condition. The questionnaire consists of eight subscales, with four allocated to mental and four allocated to physical health. Since the SF-36 is intended solely for capturing *physical health* in this study, only its four physical health-related subscales were utilized. These are: general health (SF1), physical functioning (SF2), physical role functioning (SF3), and physical pain (SF4). The items in the respective subscales use varying response formats (ranging from 3 to 5-point Likert Scales). Standardized on a common metric, all subscales range from 0 to 100.

Sociodemographic variables

We collected the following sociodemographic data: age, gender, (*cisgender:* gender identity aligns with sex assigned at birth, *non-cisgender:* gender identity differs from sex assigned by birth); education level, financial hardship, (*yes*: difficulties financing monthly expenses*, no:* able to cover monthly expenses and save, and area of residence (i.e., *rural vs. urban area*). Furthermore, experiences with racialization and ethnicization were assessed with a series of items measuring participants´ perceptions of ascribed ethnic and racial identities in Germany, developed at the University of Applied Sciences and Arts Dortmund, Germany (Dennert, 2020). It consists of four sub-items focusing on participants' perception of being seen as *"white", "German", "non-white", "non-German"* by others. Response options for the four sub-items are *never, rarely, sometimes, often, always* (Dennert, 2020). For sexual orientation assessment, participants were asked how they consider their sexual orientation (*lesbian; gay; homosexual; bisexual; heterosexual; other sexual orientation, namely…; I am not sure, prefer not to answer).* To stay within the theoretical framework on LGB individuals, our main analysis focused solely on participants identifying as lesbian/homosexual or bisexual women and gay/homosexual or bisexual men, excluding all others. Exploratory results for individuals with other sexual orientations (e.g., pansexual, asexual) will be reported elsewhere.

Statistical Analysis

Standard descriptive data will be reported (e.g., mean, standard deviation (SD), range). Distributions of main study variables (subscales of minority stress, psychopathological stress responses, resilience, health literacy and physical health) were examined for the total sample and four subgroups (lesbian/bisexual women, gay/bisexual men) separately, and Pearson correlations were calculated for all main study variables using SPSS V. 29. The hypothesized structural relationships between the study variables (hypotheses 1-3) were tested using Structural Equation Modeling (SEM) in AMOS V. 29. Cronbach's alpha will be reported for the subscales that constitute the indicator variables of the SEM. First, we tested the measurement model, followed by assessing the hypothesized model using maximum likelihood estimation. Standard Model fit characteristics will be reported. Kline (2015) suggests that at minimum the model χ^2, the Root Mean Square Error of Approximation (RMSEA), the Comparative Fit Index (CFI), and the Standardized Root Mean Square Residual (SRMR) should be reported (Kline, 2015). We will report these recommended indices; however, we report χ^2/df, instead of χ^2, since χ^2 has been shown to be highly sensitive to sample sizes and tends to be significant even in medium-sized samples (Gerbing & Anderson, 1985). In addition, we also report the Adjusted Goodness of Fit Index (AGFI) and the Incremental Fit Index (IFI). Within psychometric literature, there is some consensus, that a model demonstrates reasonable fit, if χ^2 adjusted by its degrees of freedom does not exceed 3.0, thus χ^2/df should be <3.0 (Hair et al., 2009; Iacobucci, 2010; Kline, 2004). RMSEA should be <.08 (Awang, 2012), CFI should be >.90, SMSR <.08, AGFI>.90 (Byrne, 1994), and IFI should be >.90 (Meyers et al., 2005).

Total, direct and indirect effects were determined performing bootstrapping with 5,000 replications. All total effects will be reported along with all indirect and direct effects that are required to test for the respective hypotheses on mediation. Mediation analysis was based on the classification that Zhao et al. proposed in 2010 after having critically reconsidered the prevailing approach of Baron und Kenny (Baron & Kenny, 1986; Zhao et al., 2010). The significance level for all parameters was set to $\alpha < .05$. The website "Analytics Calculator" provides a sample size calculator for SEMs: The calculator yielded a recommended minimum

sample size of *N*=288 participants (number of latent variables: 5, number of indicator variables: 18, statistical power: 0.9, expected effect size: 0.25, p-value: .05) (Soper, 2023).

Results

Sample characteristics and descriptive results

Data was collected from 02.2022-02.2023. Out of 727 participants who completed the survey, 521 remained in the final total sample after applying the inclusion criteria for the main analysis. Of those, 237 identified as lesbian women, 88 as bisexual women, 171 as gay men and 25 as bisexual men. None of the participants opted to use the 8-digit code for retrospective deletion of their data. Mean age of the final sample was 39.37 (*SD*=13.02, age range: 18-78 years), with participants identifying as bisexual being, on average, eight to ten years younger than those identifying as lesbian or gay; Overall, 94.8% were cisgender and 5.2% were non-cisgender. Average education level was high with two thirds of the sample holding A-levels. Regarding participants´ assumption of how they are perceived by others, 86.8% stated always as "*white"* (vs. 13.2% not always as "*white"*) and 60.2 always as "German" (vs. 39.8 not always as "German"). Individuals likely to have experienced racism or racialization comprise 5.8% (never to sometimes perceived as *white*) and 7.0% (never to sometimes perceived as German) of the sample, respectively. The majority (79.8%) lived in urban areas. Further descriptive data on the four subgroups are shown in Table 1.

All total mean score results, subscale results along with separate results for lesbian and bisexual women, as well as gay and bisexual men are shown in Table 2. Notably, in our sample bisexual individuals tended to experience higher levels of minority stress and psychopathological stress responses compared to lesbian and gay individuals, while lesbian and gay individuals demonstrated higher resilience. Regarding health literacy and physical health, scores were more similar for bisexual and lesbian/gay individuals. Yet, it is crucial to note age as a potential confounding factor (there was an age difference between bisexual and lesbian/gay individuals as referred to in the previous section).

The bivariate Pearson correlations among the main study variables are presented in Table 3. Overall, most of the minority stress indicator variables (M1-M6) were significantly correlated with most of the mediators as well as with the physical health indicator variables.

Results of SEM

The results of the Structural Equation Model are presented in Figure 2 (path model with standardized coefficients) and Table 4 (model fit as well as total, direct and indirect effects).

Model fit

Missing values (≤ 5.9% for all indicator variables) were replaced by mean scores prior to model fit assessment due to missing data being <10% in all instances, following Hair et al. (2009). Prior to structural equation model fit assessment, we ensured a good fit of the measurement model. Cronbach's alpha exceeded .7 for all constructs (range: .73 -.91, Table 2), indicating good internal consistency and reliability (Field, 2013). Overall, factor loadings were high, surpassing .5 for nearly all variables and surpassing .7 for many variables (Field, 2013). One exception was the lower factor loading (.18) of "community connectedness" on the latent variable *resilience*. However, accounting for Meyer's approach, suggesting that resilience in sexual minority individuals encompasses both personal *and* community aspects (Meyer, 2015) and considering the substantial sample size, we opted to retain the indicator variable "community connectedness". Model fit for the hypothesized structural equation model was acceptable (χ^2/df = 2.749; RMSEA = .058 [90% CI: .051, .065]; CFI = .940; SRMR = .056; AGFI = .906; IFI=.940). Based on the aforementioned cut-offs for model fit (method section), all model fit indices were within reasonable limits.

Total Effects

Minority stress, as the main predictor, had a significant total effect on each of the other four latent variables: Specifically, as expected, *minority stress* had a positive total effect on *psychopathological stress responses* (β =.49, p<.001) and a negative total effect on *health*

literacy (β =-.20, p<.005) and *physical health* (β =-.22, p<.001). *Minority stress* also had a significant negative total effect on *resilience* (β=-.32, p<.001) (Table 4).

Furthermore, as anticipated, *psychopathological stress responses* had a significant negative total effect on both *health literacy* (β =-.23, p<.05) and *physical health* (β =-.86, p<.005). *Resilience* also demonstrated the expected positive total effect on *health literacy* (β =.31, p<.001), as well as on *physical health* (β =.41, p<.001), while the total effect on *psychopathological stress responses* was negative (β =-.60, p<.001). However, contrary to expectation, there was no significant total effect of *health literacy* on *physical health* (β=-.04, p=.42).

Consequently, regarding total effects, H1-H3 were supported by the data: *Minority stress* has a negative total effect on *physical health* (H1) and *psychopathological stress responses* have a negative total effect on *physical health* (H2) while *resilience* has a positive total effect on *physical health* (H3).

Mediation analysis

To test the mediations postulated in the respective sub-hypotheses (a and b), both the respective direct (*c*-path) and indirect effects (*axb*-path) are required (Table 4) (Zhao et al., 2010).

Hypotheses 1a and 1b. The indirect effect of *minority stress* on *physical health* was significant via *psychopathological stress responses* (β=-.26, p<.001, MS $\rightarrow$ PSR $\rightarrow$ PH), while the direct effect was also significant (β=.16, p<.05). In contrast, the indirect effect via *resilience* was not significant (β=.03, p=.26, MS $\rightarrow$ R $\rightarrow$ PH). Thus, the negative total effect of *minority stress* on *physical health* (H1) was mediated by *psychopathological stress responses* (but not *resilience*) supporting H1a (but not H1b). According to Zhao et al. (2010) the mediation is considered competitive (*axb* significant, *c* significant, *axbxc* not positive). In this mediation, *psychopathological stress responses* acted as a suppressor variable: *Minority stress* strongly increased *psychopathological stress responses*, which in turn very strongly deteriorated *physical health*. Furthermore, the indirect effect via *resilience and psychological stress*

responses was significant as well (β =-.17, p<.001, MS → R → PSR → PH): Thus, *resilience* contributed in explaining the indirect effect of *minority stress* on *physical health*, but only, when *psychopathological stress responses* were part of the equation. The resulting substantial indirect effect that was primarily driven by *psychopathological stress responses* even resulted in a reversal of the sign of the direct path of *minority stress* on *physical health*. However, the significant negative total effect confirmed the underlying negative relationship between *minority stress* and *physical health*. This was further supported by the finding that all significant correlations between minority stress and physical health subscales were negative (Table 3). In summary, the negative impact of *minority stress* on *physical health* was primarily driven by the strong impact of *psychopathological stress responses*.

Hypothesis 2a. The indirect effect of *psychopathological stress responses* on *physical health* was not significant (β =.01, p=.34). Therefore, the total effect of *psychopathological stress responses* on *physical health* (H2) was not mediated by *health literacy*. Thus, H2a was not supported, and the relationship was direct only (Zhao et al., 2010) with a large direct effect of β =-.86, p<.005.

Hypothesis 3a. The indirect effect of *resilience* on *physical health* was not significant via *health literacy* (β =-.01, p=.27, R → HL → PH), and there likewise was no significant direct effect of *resilience* on physical health (β =-.09, p=.29). Therefore, the positive total effect of *resilience* on physical health is not mediated by *health literacy* and H3a was not supported. However, the indirect effect via *psychopathological stress responses* was significant and substantial (β =.52, p<.001, R → PSR → PH). In line with the results from H1a and b, the effect of *resilience* on *physical health* was only indirect and only significant when *psychopathological stress responses* were part of the equation.

Discussion

Discussion of main findings

The aim of this study was to provide empirical data on the impact of intersectional minority stress on the health of sexual minority individuals and explore underlying mechanisms. The main results were as follows: Minority Stress had a significant negative total effect on physical health, supporting H1. The effect was mediated by psychopathological stress responses (H1a, competitive mediation) but not by resilience (H1b). However, the indirect effect of minority stress on physical health via *both* resilience and psychopathological stress responses was significant as well, underscoring the importance of psychopathological stress responses as an explanatory factor. Hypothesis 2 was also supported: Psychopathological stress responses had a negative total effect on physical health; however, the relationship was direct only and not mediated by health literacy (H2a was not supported). Furthermore, Hypothesis 3 was supported: Resilience had a positive total effect on physical health. Here, the relationship was not mediated by health literacy either (H3a not supported). However, in line with results from H1a and b the indirect effect of resilience on physical health via psychopathological stress responses was significant and substantial. Consequently, we have provided initial evidence for some of the pathways in Lick et al.'s model within one unified framework. While validating parts of the theoretical model, we have also enhanced it by incorporating an intersectional perspective.

Besides observing the hypothesized negative total effect of intersectional minority stress on physical health, the main study finding from our perspective was identifying the key role of psychopathological stress responses in explaining how minority stress affects physical health. The results reaffirm the pivotal role of psychopathological stress responses as a result of discrimination: Intersectional minority stress negatively affects mental health, which, in turn, impacts physical health. Previous research has demonstrated the detrimental impact of discrimination and minority stress on mental health (Hoy-Ellis, 2023; Lick et al., 2013; Meyer, 2003), and likewise, the interconnection of mental and physical health has been shown before (Cohen et al., 2007; Miller & Chen, 2010). In this study, we could bridge these two aforementioned associations by showing that psychopathological stress responses serve as a mediator between minority stress and physical health in one complex model. Our results are in line with previous research, studying related concepts: For example, marginalization in older LGBT adults (≥50 years) has been shown to negatively impact physical health mediated by

mental health and health-promoting behavior (Fredriksen-Goldsen, Kim, Bryan, et al., 2017). Also, in a sample of young Israelis (aged 12-30) high levels of minority stressors and low levels of coping resources predicted lower levels of mental health which in turn predicted lower levels of physical health (Shilo & Mor, 2014). In our model, we found a substantial indirect effect of intersectional minority stress on physical health, primarily driven by psychopathological stress responses. We therefore could provide evidence for parts of Lick's conceptual framework and we also could extent this previous work by including an intersectional perspective and adding resilience as an important salutogenic factor.

Because even though resilience was not confirmed as a singular mediator, the role of resilience in the overall framework remains relevant in the sense that it mediates the effect of minority stress on psychopathological stress responses: High levels of resilience diminish psychopathological stress responses, thereby indirectly influencing physical health through these attenuated stress responses. In summary, however, it is crucial to emphasize that a significant influence of resilience on physical health was observed only when psychopathological stress responses were part of the equation. It has been suggested that resilience can function as a suppressor, when a (minority) stressor activates resilience as a "buffer" (Meyer, 2015). We found some evidence for this hypothesis, since in our sample resilience indeed buffered the psychopathological stress responses. However, in contrast, we did not find an activation of resilience by higher levels of minority stress, maybe due to reciprocal processes as discussed in the limitation section (see below).

Health literacy did not significantly contribute as an explanatory factor to physical health, as its influence was negligible compared to the impact of resilience, and particularly psychopathological stress responses. The manifestation of high levels of health literacy in better physical health as found in previous research in general population studies (Berkman et al., 2011; Schaeffer et al., 2017), was not observed in our sample.

In their classification of mediation analysis, Zhao et al. (2010) provide a flowchart for establishing and understanding mediation and non-mediation types including their implications for theory building. The significant mediation found in the SEM, according to Zhao et al., 2010, was competitive: The negative total effect of minority stress on physical health was mediated by psychopathological stress responses. According to the flowchart provided by Zhao et al.

(2010), there is evidence for the hypothesized mediator and the mediator identified is consistent with the hypothesized theoretical framework. Furthermore, the authors conclude that in cases of competitive (as well as complementary) mediation, it is likely that there might be another mediator (Zhao et al., 2010). Therefore, in this case, the provided flowchart suggests to consider the likelihood of an omitted mediator in the "direct" path. In this context, another potential mediator between minority stress and physical health could be health behavior as also theorized in Lick's (2013) model. Previous research has demonstrated that sexual minority individuals are more likely to engage in disadvantageous health behaviors, such as exercising less (Fredriksen-Goldsen, Emlet, et al., 2013) or heightened rates of drinking and smoking (Fredriksen-Goldsen, Kim, et al., 2013). In accordance, a comprehensive meta-analytic review on perceived discrimination and health in various minoritized population (not limited to sexual minorities) concluded that discrimination is both directly as well as indirectly linked to mental and physical health problems mediated by heightened stress responses and higher engagement in unhealthy and lower engagement in healthy behaviors (Pascoe & Smart Richman, 2009). Likewise, the aforementioned study in older LGBT adults confirmed health-promoting and health-risk behaviors as mediators of the effect of marginalization on physical health (Fredriksen-Goldsen, Kim, Bryan, et al., 2017).

Limitations

One major limitation of the study is that it is based on cross-sectional data. To establish definitive causality, long-term data are needed. Although this study's theoretical framework builds upon previous empirical findings that indicate certain probable directions of effects, reverse causation can only be ruled out through longitudinal studies. For instance, regarding resilience, we applied Meyer et al.'s (2015) "buffer hypothesis". Here, regarding our results, it would also be plausible that the negative association between minority stress and resilience arises because less resilient individuals perceive higher levels of minority stress, rather than experienced minority stress decreasing resilience. Mutual reciprocal processes are also conceivable.

Furthermore, the questionnaire was distributed via LGBTIQ organizations etc. Consequently, the sample cannot be considered representative and there is a risk of sampling bias: Individuals associated with LGBTIQ-supportive organizations might differ from those unaffiliated with such groups. However, those individuals more connected to LGBTIQ communities are more likely to benefit from community resilience, which in our study was found to buffer psychopathological stress responses. Conversely, individuals less connected to the community might suffer even more from minority stress and the detrimental health consequences as community support is less likely. Sampling bias may have also resulted from younger individuals potentially having easier access to the online study, given their typically advanced technological proficiency. Another limitation to representativeness arises from the relatively high educational level of the sample.

To account for intersectionality, we utilized adapted minority stress measurements that lack validation compared to the original versions. Furthermore, all health-related data were self-reported and were not validated by health experts, including physical health data. However, subjective health perception is a vital determinant of well-being, and established questionnaires were utilized whenever possible.

Another limitation lies in the relatively homogeneous composition of the sample, with only about 6-7% likely to have experienced racism. As a result, the generalizability of the findings to Black/BIPoC LGB individuals may be limited. Previous research has shown that racism, particularly in healthcare, can lead to avoidance of the health care system and to severe health consequences (Ateş et al., 2023). In her research, Amma Yeboah (2017) also illustrates how racism triggers increased cortisol and glutamate release, causing cellular damage. Hence, systematic exclusion is likely to activate self-destruct programs in the organs of Black and PoC individuals (Yeboah, 2017). Regarding intersectional experiences, the significant impact of intersectionality in daily lives of non-heterosexual Black individuals in Germany is underscored by a large survey (*N*=6,000) among Black individuals, revealing that nearly half (45.6%) of non-heterosexual Black respondents feel unsafe in public, compared to 30.3% of heterosexual Black individuals (Aikins et al., 2021). These intersectional discrimination experiences among parts of the non-heterosexual population living in Germany and their health consequences warrant further investigation due to potential underrepresentation.

Strengths

We could provide initial empirical evidence for some of the pathways postulated by Lick et al. (2013) collectively in one complex model. Furthermore, in contrast to one-dimensional approaches in many studies on minority stress, we considered the multiple, possibly interacting factors shaping unique experiences of social inequality (Crenshaw, 1989). As these factors intersect in complex ways rather than adding up linearly, it is crucial to employ questionnaires that capture individuals' comprehensive intersectional experiences and include them in complex models.

We were able to confirm and expand previous studies on older (Fredriksen-Goldsen, Kim, Bryan, et al., 2017) and younger adults (Shilo & Mor, 2014) within a sample covering a wide age range (18-78 years) while additionally extending these findings by incorporating an intersectional component and resilience as an important salutogenic factor.

While online-surveys have the disadvantage of potential sampling bias (as mentioned in the limitations), they do have the advantage of reaching diverse and often hard-to-reach minoritized populations. Hence, our results are based on a relatively large sample size.

Implications for future research

Longitudinal studies can help overcome the typical issues of cross-sectional designs. Particularly those that start early: By following young LGBTIQ individuals when they experience their first queer feelings, researchers can gain comprehensive insights into the interplay of discrimination-associated pathogenic and salutogenic processes over time.

Competitive mediation hints at the omission of one or more further relevant mediators (Zhao et al., 2010). For instance, among others, health behavior and physiological stress responses could be explored in future studies (Fredriksen-Goldsen, Emlet, et al., 2013; Lick et al., 2013)

In order to mitigate discrimination-based health risks, it is the scientific duty of democratic societies to assess effective strategies for reducing discrimination and minority

stress. Resilience significantly buffered psychopathological stress responses and therefore can help to reduce detrimental health effects on both the mental and physical level. Development and evaluation of interventions that intend to strengthen resilience in sexual minority individuals should be of future research interest. Likewise, future studies should help to develop and evaluate effective strategies for reducing minority stress.

Conclusion

In summary, supporting Lick's theoretical framework, we found evidence for a negative total effect of intersectional minority stress on physical health. This effect was primarily mediated by psychopathological stress responses, which played a crucial role in explaining the detrimental health effects as a result of discrimination. Furthermore, while health literacy only had minimal impact, resilience contributed in explaining underlying mechanism by buffering the psychopathological stress responses.

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Declaration of interests:

We report no potential conflict of interest.

Appendix:

Tables: Table 1–4;

Figures: Figure 1–2;

Supplement: Supplement A.

References: The references of the Study III manuscript are incorporated into the general reference section of this thesis to avoid duplication.

Table 1.

Sample Characteristics

	(N = 521)	lesbian women *(n = 237)*	bisexual women *(n = 88)*	gay men *(n = 171)*	bisexual men *(n = 25)*
age *(M, SD)*	39.37 (13.02)	40.76 (12.18)	32.49 (11.56)	42.04 (13.70)	32.36 (10.25)
gender (%)					
cisgender	94.8	97.5	94.3	96.5	60.0
non-cisgender	5.2	2.5	5.7	3.5	40.0
education level (%)					
left school without diploma	0.4	0.4	0.0	0.0	4.0
qualifying Secondary School Certificate, GDR: 8th grade	3.6	2.1	2.3	6.4	4.0
high school diploma, GDR: 10th grade	14.6	17.7	8.0	12.9	20.0
technical college entrance qualification	15.6	16.5	6.8	17.5	20.0
A-levels	64.1	61.6	79.5	62.0	48.0
other	1.9	1.7	3.4	1.2	4.0
estimated perception of third party (%)					
always as "*white*"	86.8	89.1	87.2	84.7	78.3
not always as "*white*"	13.2	10.9	12.8	15.3	21.7
always as "German"	60.2	63.7	57.6	59.0	43.5
not always as "German"	39.8	36.3	42.4	41.0	56.5
financial hardship (%)					
yes	9.1	9.3	11.5	6.5	16.0
no	90.9	90.7	88.5	93.5	84.0
area of residence (%)					
rural area (<20,000 inh.)	20.2	22.5	11.5	19.9	28.0
urban area (≥20,000 inh.)	79.8	77.1	88.5	80.1	72.0

Table 2.

Distribution of Main Study Variables and Cronbach's α

	range	*(N = 521)* *M (SD)*	lesbian women *(n = 237)* *M (SD)*	bisexual women *(n = 88)* *M (SD)*	gay men *(n = 171)* *M (SD)*	bisexual men *(n = 25)* *M (SD)*	Cronbach's α
Minority Stress							
harassment and discrimination **(MS1)**	1-5	2.11 (0.94)	2.17 (0.94)	2.22 (0.89)	1.95 (0.94)	2.26 (1.17)	.78
vicarious trauma **(MS2)**	1-5	3.57 (1.04)	3.59 (1.01)	3.84 (0.97)	3.52 (1.06)	3.58 (1.37)	.80
rejection anticipation **(MS3)**	1-5	2.48 (1.08)	2.45 (1.08)	2.74 (0.97)	2.33 (1.08)	2.84 (1.17)	.87
vigilance **(MS4)**	1-5	2.04 (1.07)	2.06 (1.14)	2.15 (0.93)	1.91 (1.02)	2.23 (1.12)	.86
family of origin **(MS5)**	1-5	1.91 (1.00)	2.06 (1.06)	1.73 (0.84)	1.80 (1.00)	1.85 (0.80)	.79
sexualized/physical violence **(MS6)**	1-5	2.20 (0.95)	2.31 (0.95)	2.56 (0.86)	1.86 (0.89)	2.13 (0.93)	.81
total score (4 subscales: 1-4)	1-5	2.55 (0.79)	2.54 (0.78)	2.74 (0.66)	2.43 (0.79)	2.73 (1.05)	
total score (6 subscales: 1-6)	1-5	2.38 (0.69)	2.43 (0.68)	2.52 (0.57)	2.23 (0.71)	2.52 (0.87)	
Psychological stress responses							
depression (PHQ total score) **(PHQ)**	0-27	7.94 (5.69)	7.95 (5.64)	9.85 (5.91)	6.80 (5.10)	8.80 (7.33)	.87
anxiety (BAI total score) **(BAI)**	0-50	11.85 (11.13)	12.10 (11.07)	14.67 (10.88)	9.81 (10.83)	13.60 (12.45)	.93
Resilience							
individual resilience (RS-13 total score)	13-91	66.38 (12.90)	67.11 (12.49)	61.73 (12.05)	68.01 (13.29)	64.88 (13.75)	
personal competency **(RS1)**	9-63	46.65 (8.99)	47.20 (8.75)	44.19 (8.41)	47.38 (9.39)	45.16 (9.22)	.87
acceptance **(RS2)**	4-28	19.76 (4.78)	19.91 (4.62)	17.53 (4.55)	20.63 (4.71)	19.72 (5.43)	.73
community connectedness **(CC)**	1-5	4.04 (0.76)	4.01 (0.75)	3.87 (0.71)	4.22 (0.74)	3.75 (0.82)	.79
Health literacy							
HLS-Q-EU-Index (total score)	0-50	38.07 (8.06)	37.99 (7.91)	37.13 (7.33)	38.51 (8.49)	39.13 (8.95)	
health care **(HL1)**	0-50	37.17 (8.64)	36.78 (8.61)	35.75 (7.91)	38.36 (8.60)	37.67 (10.92)	.82
disease prevention **(HL2)**	0-50	38.17 (8.84)	37.54 (8.76)	37.98 (7.63)	38.92 (9.48)	39.59 (8.96)	.74
health promotion **(HL3)**	0-50	38.97 (10.04)	39.85 (9.72)	38.15 (10.52)	37.99 (10.31)	40.17 (9.14)	.82
Physical Health							
general health (SF-36) **(SF1)**	0-100	59.08 (20.21)	59.80 (19.50)	54.27 (21.56)	60.33 (19.71)	60.72 (23.83)	.75
physical functioning (SF-36) **(SF2)**	0-100	87.60 (17.77)	86.52 (18.31)	87.39 (18.38)	90.15 (15.15)	81.20 (24.42)	.91
physical role functioning (SF-36) **(SF3)**	0-100	65.40 (39.58)	62.98 (39.70)	57.96 (40.39)	72.66 (37.99)	65.00 (40.82)	.86
bodily pain (SF-36) **(SF4)**	0-100	69.03 (26.42)	65.13 (26.79)	69.23 (26.53)	73.90 (25.42)	72.08 (24.54)	.86

Table 3.

Correlations of Measured Variables Included in Model

	MS1	MS2	MS3	MS4	MS5	MS6	PHQ	BAI	RS1	RS2	CC	HL1	HL2	HL3	SF1	SF2	SF3	SF4
MS1	1																	
MS2	.49**	1																
MS3	.56**	.41**	1															
MS4	.36**	.20**	.60**	1														
MS5	.31**	.17**	.26**	.21**	1													
MS6	.54**	.36**	.41**	.24**	.29**	1												
PHQ	.20**	.12**	.34**	.26**	.23**	.34**	1											
BAI	.31**	.16**	.36**	.28**	.21**	.35**	.67**	1										
RS1	-.14**	-.02	-.24**	-.16**	-.09	-.15**	-.56**	-.40**	1									
RS2	-.20**	-.06	-.36**	-.22**	-.09*	-.21**	-.54**	-.40**	.73**	1								
CC	-.02	.13**	.04	-.08	-.04	-.05	-.15**	-.13**	.16**	.16**	1							
HL1	-.18**	-.12**	-.20**	-.17**	-.07	-.17**	-.33**	-.33**	.32**	.30**	.13**	1						
HL2	-.11*	-.12**	-.11*	-.14**	-.06	-.11*	-.21**	-.23**	.23**	.17**	.10*	.65**	1					
HL3	-.06	-.08	-.08	-.13**	-.02	-.02	-.25**	-.20**	.26**	.20**	.09*	.55**	.67**	1				
SF1	-.12**	-.05	-.15**	-.15**	-.18**	-.20**	-.51**	-.43**	.41**	.36**	.07	.21**	.14**	.18**	1			
SF2	.00	.03	.01	-.09*	-.12**	-.12**	-.38**	-.38**	.25**	.15**	.05	.11**	.05	.08	.53**	1		
SF3	-.11*	-.06	-.16**	-.15**	-.17**	-.19**	-.42**	-.42**	.26**	.21**	.01	.16**	.08	.12**	.50**	.50**	1	
SF4	-.08	-.05	-.09*	-.10*	-.14**	-.19**	-.34**	-.38**	.17**	.18**	-.02	.14**	.11	.10*	.52**	.49**	.57**	1

Note. **p <.01, *p <.05; MS1 = harassment and discrimination (DHEQ subscale, adapted), MS2 = vicarious trauma (DHEQ subscale, adapted), MS3 = rejection anticipation (LGBT Minority Stress Measure subscale, adapted), MS4 = vigilance (DHEQ subscale), MS5 = family of origin (DHEQ subscale), MS6 = sexualized/physical violence (self-generated questions on sexualized and physical violence), PHQ = depression (PHQ total score), BAI = anxiety (BAI total score), RS1 = personal competency (RS-13 subscale), RS2 = acceptance (RS-13 subscale), CC = community connectedness (LGBT Minority Stress Measure subscale), HL1 = health care (HLS-Q-EU subscale), HL2 = disease prevention (HLS-Q-EU subscale), HL3 = health promotion (HLS-Q-EU subscale), SF1 = general health (SF-36 subscale), SF2 = physical functioning (SF-36 subscale), SF3 = physical role functioning (SF-36 subscale), SF4 = bodily pain (SF-36 subscale)

Table 4.

Results of Structural Equation Model, Standardized Total, Indirect and Direct Effects

SEM: pathways			Total Effects β (95%CI)	Indirect Effects β (95%CI)	Direct Effects β (95%CI)	Relationship
Minority Stress (MS)	→	Resilience	-.32*** (-.43; -.20)	-	= Total Effect	Neg. total effect = direct effect
	→	Psychological Stress R.	.49*** (.38; .60)	.19*** (.13; .26)	.30** (.19; .40)	Pos. total effect, direct + indirect
	→	Health Literacy	-.20** (-.31; -.09)	-.17*** (-.25; -.10) -.07* (MS → PSR → HL) -.04* (MS → R → PSR → HL) -.05* (MS → R → HL)	-.03 (-.16; .10)	Neg. total effect, indirect only
	→	Physical Health	-.22*** (-.34; -.11)	-.39** (-.51; -.27) -.26*** (MS → PSR → PH) -.17*** (MS → R → PSR → PH) .03 (MS → R → PH) .00 (MS → HL → PH)	.16* (.03; .30)	Neg. total effect, direct + indirect
Psycho. Stress Responses (PSR)	→	Health Literacy	-.23* (-.41; -.05)	-	= Total Effect	Neg. total effect = direct effect
	→	Physical Health	-.86** (-.99; -.65)	.01 (-.01; .05)	-.86** (-.99; -.66)	Neg. total effect, direct only
Resilience (R)	→	Psychological Stress R.	-.60*** (-.69; -.50)	-	= Total Effect	Neg. total effect = direct effect
	→	Health Literacy	.31*** (.20; .42)	.14* (.03; .26)	.17* (.00; .33)	Pos. total effect, direct + indirect
	→	Physical Health	.41*** (.29; .52)	.51*** (.37; .69) .52*** (R → PSR → PH) -.01 (R → HL → PH)	-.09 (-.31; .08)	Pos. total effect, indirect only
Health Literacy (HL)	→	Physical Health	-.04 (-.14; .06)	-	= Total Effect	No effect

Model fit

χ^2/df	RMSEA	SRMR	CFI	AGFI	IFI
2.749	.058	.056	.940	.906	.941

Note. ***p <.001, **p <.005, *p <.05; AGFI = Adjusted Goodness of Fit Index, CFI = Comparative Fit Index, HL = Health Literacy, IFI = Incremental Fit Index, MS = Minority Stress, PH = Physical Health, PSR = Psychopathological Stress Responses, R = Resilience, RMSEA = Root Mean Square Error of Approximation, SMR = Standardized Root Mean Square Residual, χ^2/df = χ^2 adjusted by its degrees of freedom

Figure 1.

Hypothesized Structural Equation Model

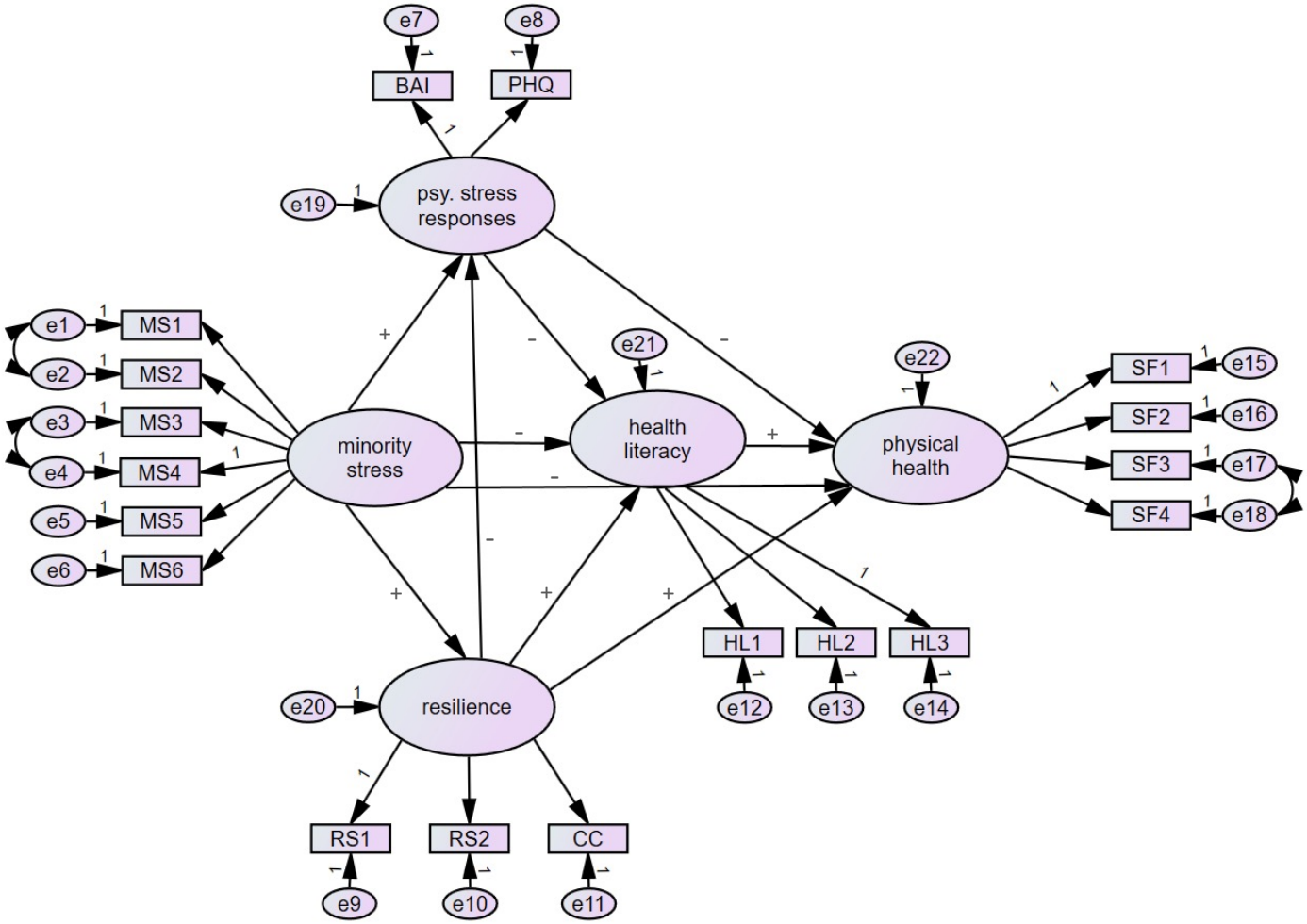

Figure 2.

Results of Structural Equation Model with Standardized Path Coefficients

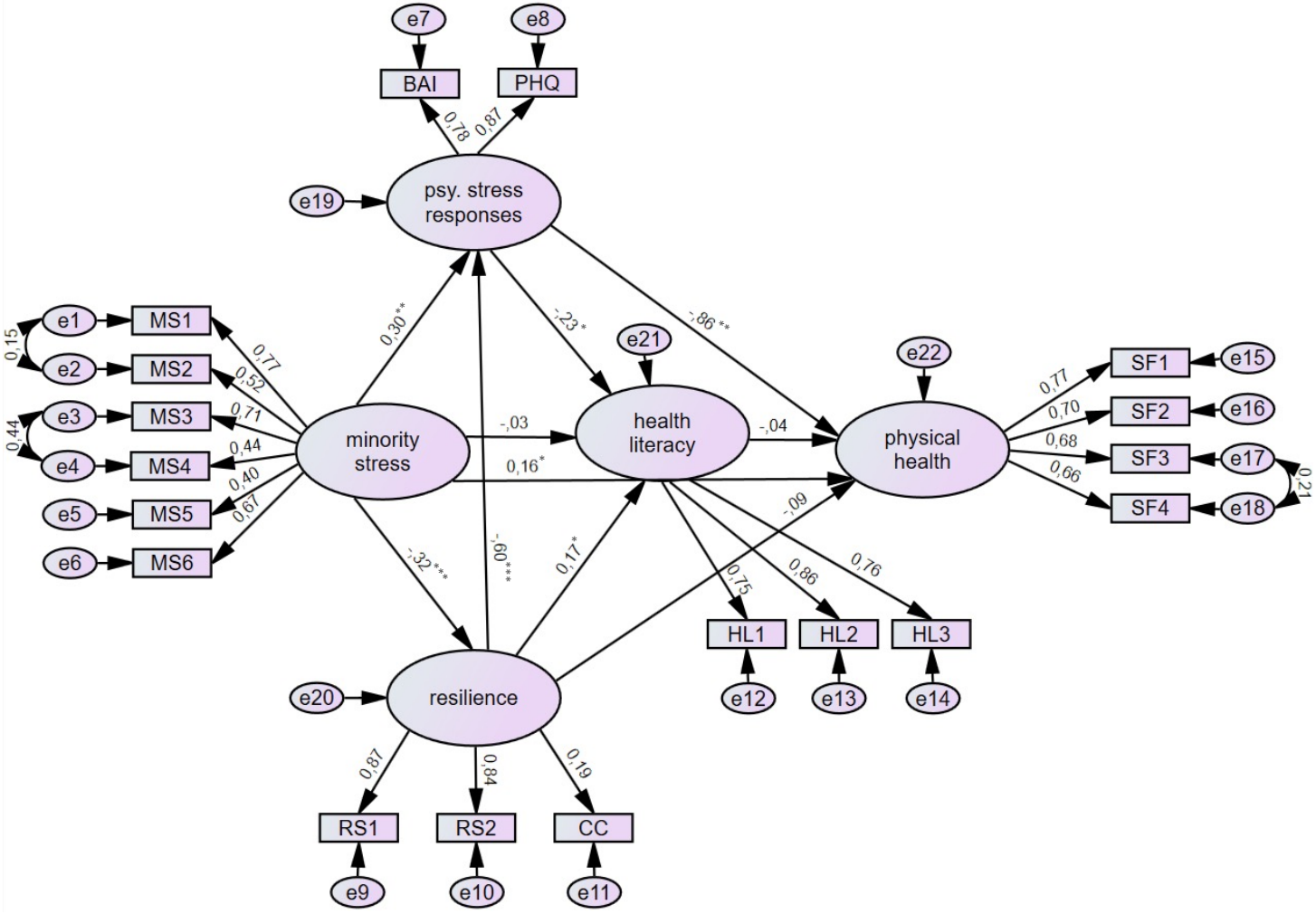

Figure Captions

Figure 1: *Note.* Model showing direct and indirect relationships between latent variables minority stress, psychopathological stress responses, resilience, health literacy and physical health; "+" represent positive and "-" represent negative hypothesized relationships; MS1 = harassment and discrimination (DHEQ subscale, adapted), MS2 = vicarious trauma (DHEQ subscale, adapted), MS3 = rejection anticipation (LGBT Minority Stress Measure subscale, adapted), MS4 = vigilance (DHEQ subscale), MS5 = family of origin (DHEQ subscale), MS6 = sexualized/physical violence (self-generated questions on sexualized and physical violence), PHQ = depression (PHQ total score), BAI = anxiety (BAI total score), RS1 = personal competency (RS-13 subscale), RS2 = acceptance (RS-13 subscale), CC = community connectedness (LGBT Minority Stress Measure subscale), HL1 = health care (HLS-Q-EU subscale), HL2 = disease prevention (HLS-Q-EU subscale), HL3 = health promotion (HLS-Q-EU subscale), SF1 = general health (SF-36 subscale), SF2 = physical functioning (SF-36 subscale), SF3 = physical role functioning (SF-36 subscale), SF4 = bodily pain (SF-36 subscale).

Figure 2: *Note.* ***p <.001, **p <.005, *p <.05, standardized path coeffients; MS1 = harassment and discrimination (DHEQ subscale, adapted), MS2 = vicarious trauma (DHEQ subscale, adapted), MS3 = rejection anticipation (LGBT Minority Stress Measure subscale, adapted), MS4 = vigilance (DHEQ subscale), MS5 = family of origin (DHEQ subscale), MS6 = sexualized/physical violence (self-generated questions on sexualized and physical violence), PHQ = depression (PHQ total score), BAI = anxiety (BAI total score), RS1 = personal competency (RS-13 subscale), RS2 = acceptance (RS-13 subscale), CC = community connectedness (LGBT Minority Stress Measure subscale), HL1 = health care (HLS-Q-EU subscale), HL2 = disease prevention (HLS-Q-EU subscale), HL3 = health promotion (HLS-Q-EU subscale), SF1 = general health (SF-36 subscale), SF2 = physical functioning (SF-36 subscale), SF3 = physical role functioning (SF-36 subscale), SF4 = bodily pain (SF-36 subscale).

Supplement A. Minority Stress Questionnaire

Minority Stress (Intersectionality) – Translated Version

We understand discrimination to mean,

- that individuals are (perceived to be) clearly assigned to a category or a group based on certain characteristics
- that they are not considered as equally valued members of society as the societal 'norm'.

The assumed 'norm' is the adult, male, heterosexual German citizen who is physically and mentally healthy. He has a good social status and education and conforms culturally (language, religion, origin) as well as in terms of other characteristics (skin color, body, gender body, gender biography, etc.,) to the society's majority. In this survey, we are particularly interested in disadvantages based on the following categories, which may also be ascribed (thus may not actually be present):

- cultural or ethnic background
- racist reasons
- sexual orientation
- migration history
- religion
- gender, gender identity, gender biography
- disabilities or chronic illnesses
- social background or social status
- age: too young or too old

Discrimination can manifest in various ways, such as insults, exclusion, sexual harassment, or violence. It is also discrimination when people are denied something that others receive (respect, attention, recognition, equal pay, etc.). It can also be discrimination if you are mistakenly assigned to the society's majority, for example being assumed to be heterosexual when you are not. Rules and conditions can also lead to people being disadvantaged.

Below, there are examples of discrimination that some people experience in our society.

Please read each item carefully, and then respond to the following question: How much has this problem distressed or bothered you during the past two years?							
How much has this problem distressed or bothered you during the past two years?	Did not happen to me/not applicable to me	It happened, and it bothered me NOT AT ALL	It happened, and it bothered me A LITTLE BIT	It happened, and it bothered me MODERATELY	It happened, and it bothered me QUITE A BIT	It happened, and it bothered me EXTREMELY	I prefer not to answer.
1. I was verbally insulted with swear words.	◯	◯	◯	◯	◯	◯	◯
2. I was stared at in public.	◯	◯	◯	◯	◯	◯	◯
3. I was verbally harassed by strangers.	◯	◯	◯	◯	◯	◯	◯
4. I was verbally harassed by people I know.	◯	◯	◯	◯	◯	◯	◯
5. I was treated unfairly in stores or restaurants.	◯	◯	◯	◯	◯	◯	◯
6. People have laughed at me or made jokes at my expense.	◯	◯	◯	◯	◯	◯	◯
7. I have noticed or heard that people I know have been treated unfairly.	◯	◯	◯	◯	◯	◯	◯
8. I have noticed or heard that people I don't know have been treated unfairly.	◯	◯	◯	◯	◯	◯	◯

9. I have heard about crimes (e.g. vandalism, physical or sexual assault) that have happened to people I don't know.	◯	◯	◯	◯	◯	◯	◯
10. I have heard that other people have been verbally insulted with swear words/insults.	◯	◯	◯	◯	◯	◯	◯
11. I have heard jokes being made about other people.	◯	◯	◯	◯	◯	◯	◯
12. I have heard politicians say negative things about certain groups of people.	◯	◯	◯	◯	◯	◯	◯
13. When I met someone new, I was worried that they secretly didn't like me.	◯	◯	◯	◯	◯	◯	◯
14. When I went out in public with my partner, I feared that people would treat us unkindly.	◯	◯	◯	◯	◯	◯	◯
15. I stayed on guard and alert because something bad might happen to me.	◯	◯	◯	◯	◯	◯	◯
16. I braced myself to be treated disrespectfully.	◯	◯	◯	◯	◯	◯	◯
17. I expected that others would not accept me.	◯	◯	◯	◯	◯	◯	◯

18. I was worried about what would happen if other people found out about certain aspects of my identity.	◯	◯	◯	◯	◯	◯	◯
19. I have watched what I say and do around heterosexual people.	◯	◯	◯	◯	◯	◯	◯
20. I have pretended to have an opposite-sex partner.	◯	◯	◯	◯	◯	◯	◯
21. I pretended to be heterosexual.	◯	◯	◯	◯	◯	◯	◯
22. I have hidden a relationship from other people.	◯	◯	◯	◯	◯	◯	◯
23. I have avoided talking about my current or past relationships when I am at work.	◯	◯	◯	◯	◯	◯	◯
24. I have hidden a part of my life from other people.	◯	◯	◯	◯	◯	◯	◯

(FILTER QUESTION): We would now like to ask you some questions regarding how your family of origin deals with your LGBT identity. Are you willing to answer these questions about your family of origin? (If you agree to answer the set of questions, you will still have the option to not respond to each individual question.)

◯ Yes, I agree to answer questions on how my family of origins deals with my LGBT identity.	◯ No, I do not agree to answer questions on how my family of origins deals with my LGBT identity.

Please read each item carefully, and then respond to the following question: How much has this problem distressed or bothered you ever in your life?

How much has this problem distressed or bothered you ever in your life?	Did not happen to me/not applicable to me	It happened, and it bothered me NOT AT ALL	It happened, and it bothered me A LITTLE BIT	It happened, and it bothered me MODERATELY	It happened, and it bothered me QUITE A BIT	It happened, and it bothered me EXTREMELY	I do not have this family member/not applicable to me	I prefer not to answer.
25. Family members have not accepted my partner as part of the family.	◯	◯	◯	◯	◯	◯	◯	◯
26. My family has avoided talking about my LGBT identity.	◯	◯	◯	◯	◯	◯	◯	◯
27. I was rejected by a parent for being LGBT.	◯	◯	◯	◯	◯	◯	◯	◯
28. I was rejected by a grandparent for being LGBT.	◯	◯	◯	◯	◯	◯	◯	◯
29. I was rejected by a sibling or siblings for being LGBT.	◯	◯	◯	◯	◯	◯	◯	◯
30. I was rejected by other relatives for being LGBT.	◯	◯	◯	◯	◯	◯	◯	◯

(FILTER QUESTION): We would now like to ask you some questions on your experiences on physical and sexualized violence. Are you willing to answer these questions on your experiences on physical and sexualized violence? (If you agree to answer the set of questions, you will still have the option to not respond to each individual question.)

◯ Yes, I agree to answer questions on my experiences on physical and sexualized violence.	◯ No, I do not agree to answer questions on my experiences on physical and sexualized violence.

Please read each item carefully, and then respond to the following question: How much has this problem distressed or bothered you ever in your life?							
How much has this problem distressed or bothered you ever in your life?	Did not happen to me/not applicable to me	It happened, and it bothered me NOT AT ALL	It happened, and it bothered me A LITTLE BIT	It happened, and it bothered me MODERATELY	It happened, and it bothered me QUITE A BIT	It happened, and it bothered me EXTREMELY	I prefer not to answer.
31. Someone has harassed me through phone calls, text messages, electronic messages, or letters with sexualized or threatening content or has spied on my private data (e.g., address) and used it in a manner that made me uncomfortable (e.g., sharing with third parties, publishing, unwanted contact)	◯	◯	◯	◯	◯	◯	◯
32. I have been harassed by whistling, sexualized comments, or staring.	◯	◯	◯	◯	◯	◯	◯
33. Someone made me feel uncomfortable through comments about my body, my personal life, sexual insinuations, obscene jokes, or intrusive sexual advances.	◯	◯	◯	◯	◯	◯	◯
34. Someone has intruded on my personal space (for example, by leaning in too close, touching me without consent, or attempting to kiss me against	◯	◯	◯	◯	◯	◯	◯

my will) or cornered me in a way that I found intrusive.							
35. Someone has followed me, stalked me, or pressured me in a way that I found uncomfortable.	◯	◯	◯	◯	◯	◯	◯
36. Someone has threatened me with rape, sexual violence, or physical violence.	◯	◯	◯	◯	◯	◯	◯
37. Someone has made fun of or trivialized victims of violence (including sexual violence) in my presence.	◯	◯	◯	◯	◯	◯	◯
38. Someone has stolen from me.	◯	◯	◯	◯	◯	◯	◯
39. Someone has threatened or attacked me with a weapon.	◯	◯	◯	◯	◯	◯	◯
40. Someone physically assaulted me in another way that frightened me or caused me harm (for example, someone pushed me, hit me, slapped me, or threw something at me).	◯	◯	◯	◯	◯	◯	◯

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