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ANXIETY TREATMENT | ANTIBIOTIC RESISTANCE
HEAT ACCLIMATION | LGBTQ+ AND POSTCOLONIALISM
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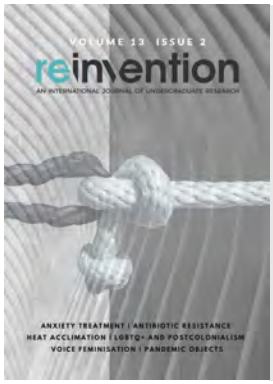

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Editorial

Reinvention: Uniting the world

Polina Zelmanova

I am delighted to extend a warm welcome to our second issue of the year of *Reinvention: An International Journal of Undergraduate Research*, Volume 13, Issue 2 (13.2). It has been a truly challenging time this year for everyone dealing with the various effects of the COVID-19 pandemic, and we hope that all our readers and their families have been able to stay safe during these times. It is strange to think that this is now the second issue produced under these circumstances, but we are once again grateful to be able to continue our work and share new research. While the world seems to have come to a standstill, now more than ever it is important for us to persevere with our goals of sharing and promoting new research, providing inspiration and a platform for the researchers of the future.

When looking at the content for this issue, I was surprised to see the various links between the themes within the papers and reviews. There is a powerful sense of uniting the 'personal' and the global, and considering the former in the latter's context. This is particularly prevalent in the two key themes of *identity* and *health* explored in this issue but also, of course, links so much to what is currently going on in the world. In our previous issue's editorial, I discussed the idea of a support network between different generations, particularly seen in the relationship *Reinvention* nurtures between undergraduate students and the wider academic community. Issue 13.2 foregrounds the root of that idea and reframes it in a broader sense – that of uniting the world.

Uniting the world is a poignant theme for *Reinvention*. We take pride in being one of the few undergraduate journals to accept submissions from all over the world, publishing students from different countries and institutions alongside each other, adding this wider dimension to interdisciplinarity. In addition to this, the editorial team itself is also international, bringing together editors from Warwick in the UK and Monash in Australia with a further diversity of backgrounds from within the team, many of whom are international students themselves. The collaboration between Monash and Warwick has always been a powerful tool for the editorial board, facilitating the sharing of resources such as academic contacts, as well as cultural experience, which can feed into our discussions.

This theme resonates particularly strongly during the COVID-19 pandemic and the other events that have occurred during this period, and has added a new sense of urgency and importance to world unity. The global nature of the pandemic has made it necessary for people and nations to unite and work together despite our many differences. While the results have not always reflected the utopian possibilities of this opportunity, there is still a sense that 'we are all in this together'. Where the leaders of the world have failed, we have seen communities come together to support each other, as has been the case with the recent examples of climate change protests and BLM. With many countries experiencing lockdowns with both local and international travel restrictions, it has been inspiring to see people finding new ways to stay connected and offer support. While we have never been further away from each other physically, in a way, we have also never been closer, with individuals and organisations experimenting with digital platforms to connect with each other, expanding their reach and, also, opening up new opportunities in preparation for when things eventually go back to a new 'normal'.

Issue 13.2 brings together a wonderful selection of content, including five original research papers, two book reviews and two exhibition reviews. The interdisciplinary nature of the journal means that we do not intentionally publish 'themed' issues; however, we should not be dismissive about investigating our issues in terms of a unity of content. As you read the articles and reviews, I would urge you to view them not just as individual pieces but as a collection that, when considered together, highlights a larger message.

Our new issue opens with Jenifer Elmslie's paper 'The Postcolonial Legacy and LGBTQ+ Advocacy in Egypt and Lebanon'. The research uses Egypt and Lebanon, two previously

unexplored examples, as case studies to examine the challenges faced by LGBTQ+ advocates. Focusing on the Middle East and North Africa, and Arab cultural identity, the paper contextualises this in a global context of LGBTQ+ activism, raising issues of difference and multitudes of identity. There is an undeniable link presented between the personal and the global, uniting the two not just through similarity, but through an equally important difference of identity.

Expanding further on the theme of identity is Cody Ritz's paper titled 'Constructivism over Determinism: An examination of two conflicting philosophies to voice feminisation for transgender women'. Ritz examines techniques and methods used in the feminisation of voice as part of the transition process for transgender women. Through its discussion, the paper emphasises the need to expand our notion of what contributes to therapeutic voice intervention to include not just physical attributes, but also social and cultural ones. The paper wonderfully crosses over between medical and social studies, demonstrating the paper's interdisciplinary nature, but also the need for the inclusion and consideration of both when it comes to therapeutic voice intervention practice.

Rebecca Kirkham and Caitlin Batten's 'Public Perceptions on Using Virtual Reality and Mobile Apps in Anxiety Treatment: A cross-sectional analysis' is another paper employing an interdisciplinary approach. As the title suggests, the paper examines the role that virtual reality and mobile apps can play in the mental health system and treatment, as well as what might be hindering their use. While the topic was current at the time of writing and initial review, considering these methods and ideas in the context of COVID-19 and an increasing trend towards the virtual even in the case of health shines a new urgency on the subject's exploration.

The next paper is also a co-authored one but also an international collaboration, titled 'Knowledge and Habits Towards Antibiotic Use and Resistance of Public University Students in Nisava Region – Southern Serbia' by Nemanja R Kutlesic and Aleksandra Jovanovic. The study emphasises the issue of misusing antibiotics and its threat to global health. It investigates to what extent young people in the Nisava region are aware of correct antibiotic use through a comparison of responses in other countries and considers the difference between that awareness and the actual use of the medication.

Our final paper is 'Post-Exercise Hot Water Immersion Promotes Heat Acclimation Responses in Endurance Athletes and Recreational Athletes: A systematic review and

meta-analysis' by Jack Martin. The paper looks at the uses of heat acclimation for athletes through a systematic review. While it examines the benefits of the process for all athletes, the quantitative evaluation particularly highlights whether hot water immersion can produce similar effects associated with heat training, a discussion particularly useful for non-professional athletes or athletes that have limited resources.

This issue also offers a wonderful set of reviews, complementing the original research papers. The first of these are the two reviews for the book *Guest House for Young Widows – Among the Women of ISIS* by Azadeh Moaveni published in 2019. The reviews come from Helen Stenger and Alicja Lysik, an academic and a student offering complementary thoughts, discussing the approach to such a complex topic as well as its importance in terms of representation. Stenger is a doctoral candidate at Monash University's Gender, Peace and Security Centre, and her research investigates gender dynamics of rehabilitation and reintegration of women extremists, and Lysik is a recent law graduate from the University of Warwick who has just started working as a Future Trainee Solicitor at Reed Smith in London.

This is the second issue in which our book reviews have been complemented by exhibition reviews. In this issue, we have reviews of two exhibitions: *Pandemic Objects: Photograph* by Duncan Forbes and Marcela Chao reviewed by Sarah Sullivan, a Law (Honors) & Art undergraduate student in her fourth year of study at Monash University, and Harriet Reed's *Pandemic Objects: TikTok* reviewed by Alice Kunjumon who is currently completing a Bachelor of Secondary Education (Hons) and Arts at Monash University. Both exhibitions are part of the Victoria and Albert Museum's *Pandemic Objects* project which re-examines and reflects on objects whose meaning may have shifted in light of the current pandemic. As has been the case with so many aspects of our lives, these curatorial projects have also taken place online, in itself shifting our ideas and experience of exhibitions and art.

Finally, concluding our issue is a guest article from Peter Halat, who is an alumni Editor of *Reinvention.* In his piece, Halat examines the necessity and role of undergraduate research from the perspective of a PhD student. His article reflects on his experience as an undergraduate researcher and how he has been able to utilise the skills he learnt even in postgraduate studies. I hope this piece inspires more undergraduates to think of themselves as researchers and as valuable contributors to academia, even during the early stages of their studies.

In our last issue, I urged researchers to consider the future implementations of their work. Considering the content and themes of this issue, I want to add to this the importance of framing the research within a wider context. All of the papers in this issue have a unique relationship to the world around us, on both a local and global scale, making a vital contribution not only to their individual fields but also to a wider conversation on their topics.

On this note, I conclude my role as Editor at *Reinvention* and pass the torch on to Auni Siukosaari who will be taking over the role following the publication of issue 13.2. Working at *Reinvention* has been such an incredible opportunity and has opened my eyes to academic studies beyond my own degree, which, as academia slowly steers towards interdisciplinarity, is extremely useful. It has been so inspiring to be a part of a larger undergraduate research community and meet so many people, both staff and students, who are passionate about the importance of undergraduate research. I want to thank the Journal Managers both at Warwick and Monash and the assistant editors I have worked with over the past year for contributing to such an immensely stimulating environment during our meetings and discussions – I've learnt so much from every single one of you in more ways than one. I want to wish you all the best and I am excited to keep following the journal and see where Auni Siukosaari takes things next, particularly as there are so many exciting projects lined up for the year ahead!

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The Postcolonial Legacy and LGBTQ+ Advocacy in Egypt and Lebanon

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Abstract

In recent years, increased crackdowns on and legal persecution of LGBTQ+ rights in the Middle East and North Africa (MENA) have occurred as a result of the renewed use of colonial laws against 'sexual deviance' and 'debauchery'. Sexual politics have emerged as a site of political domination in part as a result of financial and political crises in the region. This paper explores the various challenges faced by LGBTQ+ advocates in the MENA in the twenty-first century. The paper argues that advocates can overcome these challenges by separating their message from both International LGBTQ+ groups and domestic anti-LGBTQ+ dialogues, which converge in the view that LGBTQ+ identity and Arab cultural identity are permanently, inherently opposed. Using a Postcolonial International Relations framework and critical cultural theory, this paper will investigate the complex web of oppressions these advocates face. Two previously unexplored contemporary examples in Egypt and Lebanon will be investigated, focusing on advocates' alliance-building capabilities and creation of a *war of position*. Using a deductive approach, the paper will conclude that LGBTQ+ advocates are able to overcome these challenges. The theoretical framework is therefore a useful tool in the study of modern international relations and culture.

Keywords: LGBTQ+ advocacy, Middle East and North Africa LGBTQ+ rights, Postcolonial IR theory, critical cultural theory, underground LGBTQ+ activism, cultural hegemony, LGBTQ+ crackdowns.

Introduction

> We are caught between neo-colonial agendas on the one hand, and regressive, oppressive local governments on the other.
>
> — (Helem, 2006)

LGBTQ+ advocates in the Middle East and North Africa MENA ('the region', 'the Arab world') face challenges from both repressive domestic and international rights discourses. Domestic discourses construct LGBTQ+ identity as alien to regional cultural identity, justifying the legal and social repression of LGBTQ+ rights and people. Additionally, scholars such as Massad (2002) contribute to discourses presenting LGBTQ+ identity as a Western incursion in their critique of the cultural essentialism of International LGBTQ+ (ILGBTQ+) rights groups. These two discourses converge to present LGBTQ+ rights discourses and advocacy as inherently foreign to regional cultural identity. The strategies of some LGBTQ+ advocates in the region position their advocacy to oppose both of these discourses, constructing a counter-hegemonic movement through a *war of position*.

Methodology

This paper uses critical theoretical perspectives, Postcolonial International Relations (IR) theory and critical cultural theory, as its conceptual framework, explored in the literature review.

Primary news media and documentary sources are used for the analysis presented in the two *Strategies* sections below. They were chosen by purposive sampling – a sampling method wherein the author chooses their own sources, common in qualitative case research. This method provides insights into wider modern regional trends, analysed through the chosen theoretical framework.

An in-depth analysis of the complexities of individual national cultures, including analysing every country's laws and economic and cultural backgrounds, was beyond the scope of this research. Two example countries, Egypt and Lebanon, were chosen. Both countries have an existing but limited LGBTQ+ rights discourse and both have laws that are used to restrict the freedom of LGBTQ+ people (Human Rights Watch (HRW), 2018: 65–66, 68). This paper cannot provide a comprehensive regional analysis, but rather offers a novel insight into the contemporary discourses in two similar regional States. The analysis supports the usefulness of the chosen theoretical framework in understanding modern events relating to culture and LGBTQ+ rights in the region, in its deductive approach.

Benefits of this approach

This post-structural, post-empiricist approach departs from mainstream rationalist and empiricist ontologies and quantitative research methods. The research is openly political, anti-colonial and favourable to pursuing justice in modern conflicts by drawing attention to marginalised subjects and scholarship.

Literature review

Mainstream approaches and their limitations

Mainstream IR approaches embrace structuralist views of cultural permanency. Realist theorists such as Huntington (2011) argue that anti-LGBTQ+ attitudes in the region are culturally permanent due to regional conservative 'political culture', based on the permanent values of discrete cultural and religious identities. Perspectives like these are critiqued by Postcolonial scholars for ignoring the interdependency of cultures and cultural change over time, and using essentialising perspectives (Saïd, 1978). Mainstream IR approaches that are rooted in the Western tradition include Realist theory, Liberal theory and the English School. These approaches subscribe to metaphysical notions of binaries between West and East or the notion of West-as-Subject. They adopt positivist, empiricist methodologies in their analysis (Saïd, 1978). Mainstream approaches are not used in this analysis and the use of a critical approach must be justified.

Chosen approach: Postcolonial theory and critical cultural theory

This paper uses a Postcolonial and critical cultural theoretical and epistemological framework to examine the legacy of colonialism on rights discourses in regional States.

The point of reference

Postcolonial scholars problematise mainstream, Western-centric discourses about the region. Inherent to these approaches is a metaphysical binary: the apparent epistemological and ontological distinction between 'West' and 'East', defined by Edward Saïd as 'Orientalism' (1978). Here, Eastern countries are presented as primitive and backwards; hence, the enlightened Western Subject and its perspective should constitute the universal point of reference. Challenging this, Postcolonial theory empowers the

'colonized subaltern subject' (Spivak, 1998: 79). The theory instead uses marginalised perspectives from the Eastern Subject as points of analysis.

National difference

The Postcolonial approach challenges traditional religion – and culture-rooted explanations of dominant anti-LGBTQ+ attitudes in the region; instead, linking these attitudes with the legacy of colonial domination (Abdulhadi, 2009). Chatterjee (1993) examines the formation of national difference in formerly colonised States in order to differentiate their 'inner domain' of national culture from that of their former-colonisers. This is linked to socio-economic insecurities – including financial crises, which have caused insecurity, creating a need for the States to reassert power over their citizens (Pratt, 2007). Parker (1992) identifies a link between heterosexual identity and the ability of States to maintain this cultural difference. Using this theory allows for the critical examination of the roots of cultural difference.

ILGBTQ+ rights and opposing scholarship

Discourses surrounding International LGBTQ+ (ILGBTQ+) rights groups should also be considered. These groups attempt to universalise the LGBTQ+ experience by reinforcing the universality of sexual identity groups. Critics of these groups, notably Puar and Rai (2002) and Massad (2002), challenge ILGBTQ+ groups, critiquing their internationalist and anti-Arab approaches. However, this academic discourse ultimately harms the work of indigenous LGBTQ+ advocates. It does this by, perhaps inadvertently, presenting LGBTQ+ identities as a Western cultural incursion. LGBTQ+ advocates, in turn, are presented as Western agents (Habib, 2009: xix), justifying their legal oppression and social ostracisation. This will be further explored in the analysis.

Critical cultural theory

In opposition to theories of political culture, cultural theorists Hall (2016), Gramsci (2007) and Hebdige (2003) offer critical analyses of the relationship between national culture and sexual politics. Hebdige argues that subculture is a challenge to cultural hegemony, confronting the status quo (the ideological domination of the ruling class) through breaking from the dominant culture (here, sexual identity and practices). Crucially, these hegemonic discourses are reproduced by cultural processes which appear 'permanent and 'natural' (Hebdige, 2003: 16). Hall (2016) argues that mainstream culture

is not static and must be constantly reproduced through social and cultural practices. Counter-hegemonic struggles can be understood as either a *war of manoeuvre* (a direct confrontation between the people and those in power, which will not necessarily dismantle hegemony) such as the Arab Spring, or a *war of position* (an ideological struggle against hegemonic ideas needed to create a counter-hegemony) such as the 1917 Russian revolution. The latter is described by Gramsci as a 'resistance to domination with culture… as its foundation' (2007: 168). The war of position is the most revolutionary, fundamentally undermining the political/economic fabric of society, uprooting the status quo, and revealing possibilities for 'new political subjects and subjectivities' against the dominant culture (Hall, 2016: 190).

Additionally, the role of globalisation in creating homogenised global sexual politics and identity must be acknowledged (Altman, 2004). This includes the advent of the internet by the late-1990s (Khan, 2009). However, this paper will attempt to reveal the less-explored critical colonial aspect in the formation of globalised sexual politics.

Challenges faced by LGBTQ+ advocates in the Arab world

LGBTQ+ advocates are challenged on multiple fronts by discourses that present the quest for LGBTQ+ rights as inherently foreign to regional cultural identity.

Challenges posed by domestic discourses

At the local level, States in the region create and reinforce discourses constructing LGBTQ+ identity as alien to regional cultural identity, legitimizing the legal and social repression of advocates. State crackdowns on LGBTQ+ advocacy and people have accelerated in recent years; this advocacy has recently entered mainstream public discourse in some regional States due to increased visibility (Khan, 2009: 30). These crackdowns are, in part, fuelled by political and socio-economic factors, legitimised by references to cultural identity and anti-colonial nationalism. In this way, they are 'a direct result of the colonial project' (Abdulhadi, 2009: 471).

National difference

Anti-LGBTQ+ crackdowns can, in part, be understood as a performance of sovereignty by formerly colonised States. This performance, through the production and reinforcement

of national difference from former-colonisers, has a long history within anti-colonial movements of producing the 'spiritual domain' of national culture (Chatterjee, 1993: 26). The need for a site of political domination exists in the contemporary context of 'socioeconomic insecurities and political processes,' including economic crises (Pratt, 2007: 130). The 2011 Arab Spring resulted in major uprisings and civil wars in a number of regional States. The liberalisation of a number of economies occurred in 1991 as a result of economic reforms from the international community to fund national development, agreed between the IMF and World Bank (Pratt, 2007: 134–35). Pratt demonstrates that this structural shift was felt both economically, a 'loss of income, unemployment or reduced access to decent healthcare and education' and culturally, an 'impact upon gender roles, relations and identities,' (2007: 135).

The use of anti-LGBTQ+ discourses by the political class has become a site of domination, punishing those who are considered by the mainstream to be sexually deviant. It distinguishes the (cisgender-heterosexual) behaviour of domestic citizens from that of citizens of Western former-coloniser States, creating 'sexual difference'. It should be noted that this point, of course, only applies to the recent application of these laws that were, for the most part, written under colonial mandates. This is because Britain and France have historically criminalised the same acts but now largely do not. Thus, in a paradoxical way, countries like Lebanon and Egypt inherited these laws from their former colonisers, and now use them to distinguish their culture from these formerly colonising countries. This point will be further elaborated in later sections. As Parker (1992) posits, issues of sexual politics are performed on the map of national identity; conservative approaches towards sexuality serve as a marker of regional cultural identity. This justifies the legal and social repression of LGBTQ+ rights through discrimination against LGBTQ+ people by regional States (HRW, 2018: 6–13). Indeed, of the 19 nation-States in the region, only Jordan and Bahrain eliminated strict laws against homosexuality imposed by colonial legal systems after gaining independence (HRW, 2018: 6). Today, the majority of States in the region treat homosexual acts as a criminal offence; only Iraq and Jordan have no laws explicitly criminalising homosexuality (HRW, 2018: 6–13). There is no official pathway recognising an individual's right to change their legal gender from the gender that was assigned to them at birth in any State in the region (HRW, 2018: 11–13).

Cultural hegemony

Alongside an understanding of the role of national difference, a critical cultural analysis of the creation and maintenance of cultural hegemony further accounts for the existence of anti-LGBTQ+ discourses in the region. A Gramscian understanding of the operationalisation of power in society (Gramsci, 1988) reveals that culturally hegemonic discourses challenge LGBTQ+ advocacy. Dominant cultural attitudes are constantly reproduced by political and civil society through processes that appear to be 'permanent and "natural"' (Hebdige, 2003: 16). This presents anti-LGBTQ+ attitudes as a cultural permanency, and LGBTQ+ rights advocacy as a Western creation. The constant reproduction of dominant cultural hegemony benefits political forces who are able to 'maintain regime authority within nation-State boundaries' (Pratt, 2007: 143).

Hegemonic anti-LGBTQ+ discourses, deeply linked to colonial legacies and contemporary socio-economic and political factors, emerge as a site of domination to reproduce current power relations and protect regional identity by creating difference from the West. This justifies the legal and social persecution of LGBTQ+ people and rights advocates, who can be dismissed as agents of 'imperial sabotage' (Habib, 2009: xix).

Challenges posed by ILGBTQ+ rights groups and opposing scholarship

Scholars have rightly criticised ILGBTQ+ rights discourses for their essentialising and anti-Arab tendencies. This academic critique, however, goes too far, creating problems for Arab LGBTQ+ advocates by reinforcing perceptions that LGBTQ+ identity is inherently foreign to the region.

Scholars have linked progressive ILGBTQ+ movements with a form of modern imperialism, critiquing these activists' subscription to Western categories of identification. Puar identifies 'homonationalism' as a site of cultural difference between the imagined Western and Arab worlds, arguing that ILGBTQ+ groups have a right-wing nationalist ideology (Puar, 2007; Puar and Rai, 2002: 1–36). Massad (2002) coined the term '*Gay International*' to include a cluster of NGOs (including the National Gay and Lesbian Task Force and the International Lesbian and Gay Association) whose goal is the universalisation of LGBTQ+ identity politics. By this, Massad means 'transforming' people in the region 'from practitioners of same-sex contact into subjects who identify as homosexual and gay' (2002: 362).

Massad refers to those who construct the 'academic literature of historical, literary, and anthropological accounts' as being 'supporters' of the *Gay International* (2002: 362). This universalisation is produced by scholars through the exploration of historical texts to argue that homosexuality has historically been accepted in the Arab world, purporting that the longing to identify as 'gay' and be 'out' is universal (Boswell, 1980: 194; AbuKhalil, 1993: 33–34). This is also produced by cultural reproductions in civil society, including websites featuring tips for homosexual European and American tourists visiting the region, written in English. For example, Pratt refers to the prominent Egyptian website at the time *gayegypt.com* (Pratt, 2007: 131). This site has since been shut down.

According to Massad, ILGBTQ+ groups are inherently anti-Arab, and have an 'orientalist impulse' (2002: 362). They present the Western model of sexual freedom 'as the only possible—and universally applicable—liberatory telos' (2002: 365). This model oppresses LGBTQ+ people in the Arab world by creating homosexual *identity* where homosexual *desire* existed; Massad argues that homosexual identity is not indigenous to the Arab world and 'gayness' is a Western import (2002: 364). A crucial distinction must be made here between *desire* and *identity* in his argument; not all sexual desires become sites of identity. Visibility strategies, including 'coming out' and pride marches that ILGBTQ+ groups promote, are an 'incitement to discourse' (Massad, 2002: 371), which creates a national discourse and sexual identity where none existed. Massad argues that the 'socio-political identification of these practices with the Western identity of gayness' (2002: 382) intensifies anti-LGBTQ+ rhetoric in the region, bringing about 'more repression, not "liberation", and less sexual freedom rather than more' (2002: 383).

Massad is right to identify the essentialising, anti-Arab views of some groups that he considers to be the *Gay International*, which adopt a Western imperialist discourse that has 'fed into the colonial project' (Abdulhadi, 2009: 474). There are negative aspects of the universalisation of LGBTQ+ identities; in particular, a neo-colonial exploitative gay sex tourism (Massad, 2002: 376, 381–82). It is also true that these groups position the universal, secular, pro-LGBTQ+ rights discourse as the only way Arab LGBTQ+ people can be 'saved' from repressive local regimes, essentialising regional political culture (Abdulhadi, 2009: 474). However, Massad's theory contributes to the axis of oppression faced by LGBTQ+ advocates in the region. Habib argues that theories like Massad's, which assert that 'gays and lesbians in the Arab world do not exist' (Habib, 2009: xvii)

divorces Arab people from the possibility of authentic LGBTQ+ identity by reducing same-sex identity to a 'Western paradigm' (2009: xviii). Portraying advocates as 'agents of Western imperialist sabotage of Arab nations' (2009: xix), these approaches suggest that the 'true patriot' should protest 'Western attempts to infiltrate and destroy the nation' (2009: xliv). This demonstrates an 'insensitivity to the very real struggles' that advocates face (2009: xliv) by offering 'criticism without options for liberation,' (Abdulhadi, 2009: 482). It does not suggest a way in which local LGBTQ+ groups could critically consider their approach to advocacy. Massad 'perhaps unwittingly' oppresses these groups (Habib, 2009: xix).

Crucially, Massad oversimplifies the modern emergence of identitarian sexuality as a 'Western sexual epistemology' (2002: 374), a colonial imposition on the Arab world, through an authenticity/inauthenticity binary. A modern epistemology of sexuality better explains the emergence of modern sexuality as a form of disciplinary power wherein homosexuality is categorised and becomes a marker of identity, in opposition to heterosexuality (Foucault, 1979: 43). The categorisation of sexuality, a result of modernity, was heavily influenced by colonialism and cannot be understood as natural and universal in either the Western or Arab worlds; all identities are constructed. However, LGBTQ+ identity in the region can still be understood as authentic. Habib understands 'identitarian' sexuality to have naturally migrated to the region, having been 'voluntarily adopted' (Habib, 2009: xxxvii) by Eastern epistemologies of sexuality, rather than through an exclusively colonial imposition (2009: xix) that should be rejected and persecuted.

These two discourses, domestic discourses produced by the State and discourses produced by anti-*Gay Internationalist* scholars, converge to present the work of LGBTQ+ advocates as inherently alien to Middle Eastern culture. This restricts the options of LGBTQ+ advocates to either (a) mobilise and be seen as 'an agent of the *Gay International*' or (b) to not mobilise (Abdulhadi, 2009: 481).

Strategies of LGBTQ+ advocates in the Arab world

The strategies of LGBTQ+ rights advocates in the region position them against both explored discourses: as both counter-cultural movements and indigenous to the region.

Underground methods

Advocacy in the region is largely undertaken underground and outside State structures, using creative and unconventional methods rather than methods seen in the West, including legal advocacy and public protest (HRW, 2018; Issa, 2016). This approach sets LGBTQ+ advocates in the region apart from Western groups. The Arab Foundation for Freedom and Equality (AFE) publishes online press releases regarding internet safety measures for LGBTQ+ people to prevent their social and legal persecution (AFE, 2015). Online statements condemn LGBTQ+ persecution, serving as protests, online education, and a call to action against State repression (AFE, 2017). This is also seen in the reporting of the recent banning of the gay dating app 'Grindr' in Lebanon by popular LGBTQ+ site *SMEX News* (2019a). The site's publication of tips for protest and internet safety also demonstrates this, including describing how to safely document human rights violations in the 2019 Lebanon protests (SMEX News, 2019b). Advocacy and education strategies focus on safeguarding LGBTQ+ people in the region rather than encouraging them to come out, which incites public discourse, as Massad suggests (2002: 371). This sets the group apart from ILGBTQ+ groups, challenging discourses presenting all LGBTQ+ advocates as foreign incursions.

Alliance building

The alliance-building and solidarity-focused activities of regional LGBTQ+ advocacy groups build connections with other rights movements in the region, including feminist and human rights organisations (HRW, 2018: 36–9). This re-joins regional LGBTQ+ advocacy with other indigenous forms of rights activism, challenging discourses presenting LGBTQ+ advocates as proxies for Western interests. LGBTQ+ groups' success is in large part dependent on their ability to 'build ties with forces struggling for comprehensive social change' in the region (Abdulhadi, 2009: 482).

The overall strategy posed by LGBTQ+ rights advocates is their ability to create a counter-hegemonic discourse in a *war of position*. The counter-hegemony that these advocates construct sets their message apart from ILGBTQ+ rights discourses, discourses presenting LGBTQ+ rights advocates as a Western incursion, and domestic anti-LGBTQ+ cultural discourses. The resulting ideological struggles from cultural forms of resistance

reveal the possibility for 'forms of social and political struggle' (Hall, 2016: 190) against dominant cultural hegemony and the power structures that it upholds.

Egypt and Mashrou' Leila

During a September 2017 concert in Cairo by Mashrou' Leila, an LGBTQ+-friendly rock band, rainbow flags were flown (Egyptian Streets, 2017). A crackdown on LGBTQ+ rights in the country followed, reported by numerous newspapers and rights organisations (Egyptian Streets, 2017; HRW, 2017; Reuters, 2017; The New Arab, 2017; The New York Times, 2017).

Following the concert, the Egyptian Syndicate of Musical Professionals banned Mashrou' Leila from performing in the country, accusing them of promoting 'abnormal art', and the Egyptian Interior Minister described the band's advocacy as contributing to 'internal disagreements' (Egyptian Streets, 2017). A formal 'media blackout' was imposed by the Supreme Council for Media Regulation, prohibiting the 'promotion or dissemination of homosexual slogans' (HRW, 2017). An estimated 65 people were arrested by the end of October, some of whom were subject to forced anal examinations (HRW, 2018; New York Times, 2017). Legal charges brought against them included the vague charge of 'promoting sexual deviance and debauchery' (Reuters, 2017; HRW, 2017).

Challenges

The origin of anti-LGBTQ+ laws in Egypt is linked to its colonial history, as it is in Lebanon. The 1951 laws used today to penalise LGBTQ+ people in Egypt were written under colonial influence, before the Republic of Egypt was established in 1953 (HRW, 2018: 65–66).

The 2011 Arab Spring protests in Egypt, a direct confrontation between the people and those in power, challenged the legitimacy of the Egyptian ruling class. Economic insecurity in Egypt is comprehensively explored by Pratt (2007: 135–36) and continues today; in April 2019, '60 percent of Egypt's population' was 'either poor or vulnerable, and inequality is on the rise' (World Bank, 2019). Socio-economic and political insecurities foster the need for a site of political domination.

The references of government officials in the above section to 'abnormal art' (Egyptian Streets, 2017) and 'deviance and debauchery' (Reuters, 2017) reinforces the cultural discourse that LGBTQ+ rights advocacy is by nature foreign to Egyptian cultural identity. The social and legal exclusion of LGBTQ+ people who are considered to be sexually deviant is made legitimate through this discourse. Advocates are portrayed to be agents of an outside intrusion and identified as a threat to cultural identity, 'alienated as a saboteur, dismissed as an infiltrator' (Habib, 2009: xxvi). The protection of cultural identity, through the State by rights violations against LGBTQ+ individuals, is in this way justified.

A critical cultural perspective reveals that descriptions of LGBTQ+ advocacy causing internal disagreements is a clear example of the securitisation argument surrounding LGBTQ+ advocacy, which threatens cultural hegemony. The guarding of national sovereignty and unity excludes the possibility of cultural fluidity and heterogeneity (Pratt, 2007: 135–37).

This case demonstrates how States construct discourses separating LGBTQ+ identity from cultural identity in what is presented as the national interest. In reinforcing this cultural hegemony, States legitimate their power through security dialogues in response to agitations following political/economic crises (Pratt, 2007: 130). This justifies the continued persecution of LGBTQ+ people.

Strategies

The strategies of these LGBTQ+ advocates demonstrate a cultural war of position. In interviews, lead singer Hamed Sinno has drawn attention to both the homophobic attacks he faces in the Arab world, and the anti-Arab *and* homophobic attacks he faces in the West, stating that the latter is more prominent and threatening (CBS News, 2016). Sinno's discussion of a liberal Arab world that accepts homosexuality (Attitude Magazine, 2019) presents local LGBTQ+ movements as indigenous by suggesting the movement can emerge authentically within the region. The singer claims that Mashrou' Leila's advocacy 'opens the floor for… renegotiating society as we know it' (Attitude Magazine, 2019). This challenges the hegemonic discourse understanding that Arab and LGBTQ+ issues are antithetical, creating the space in which both experiences can be lived together.

In 2012, Mashrou' Leila cancelled a concert with popular Western rock band Red Hot Chili Peppers after the band refused to support the Boycott, Divestments and Sanctions (BDS) movement against Israel (The Electronic Intifada, 2012). By publicly advocating for issues impacting the Arab world through solidarity, this move marries LGBTQ+ advocacy with Arab rights advocacy. No longer are the two antithetical; it is possible to advocate for both and be both.

By criticising the West, opposing Western interests and advocating for Arab and LGBTQ+ issues together, the band challenges hegemonic discourses understanding that the two are antithetical. This war of position promotes the possibility of an LGBTQ+-friendly Arab world.

Lebanon and Helem

Helem is a Lebanese not-for-profit organisation that promotes the legal and social status of LGBTQ+ people in the region, the first advocacy group of its kind in the Arab world. The group has been labelled as 'Western proxies' by both repressive local discourses and critics of ILGBTQ+ groups. This label challenges their legitimacy by portraying their advocacy as a foreign incursion. This is particularly clear in the debate between Colombia University academic Joseph Massad and Helem's Ghassan Makarem over the legitimacy of the group's advocacy.

Challenges

Massad has claimed that Helem 'want to assimilate into the Western gay movement' (Massad, 2009a), and that the group is funded by 'Gay Internationalist organizations' (2009b). Massad's argument has already been explored in this paper. By associating Helem with ILGBTQ+ groups, the group becomes a target of suppression, as a foreign incursion. His argument mirrors dominant cultural dialogues that view LGBTQ+ identity and Arab cultural identity as inherently opposed, such as those expressed by government officials in Egypt. As agents of 'imperial sabotage' (Habib, 2009: xix), Helem's persecution is justified: they are seen as a colonial imposition that must be eliminated for the protection of the nation.

Similar to the Egyptian case, the repression of LGBTQ+ people in the country includes crackdowns against LGBTQ+ people (HRW, 2019). The origin of anti-LGBTQ+ laws in Lebanon is also linked to colonialism; laws used today (HRW, 2018: 68) are remnants of French colonial occupation (Pratt, 2007: 6).

Strategies

Helem has defended its status as part of an indigenous rights movement, creating a war of position by untethering LGBTQ+ identity from its apparently Western origins.

Helem's Ghassan Makarem denies Massad's claims that the group is controlled by a Western Gay Internationalist agenda (Makarem, 2009). Makarem posits a more complex account of 'subject formation' and claims that Massad's critiques are ultimately 'essentialist' (Makarem, 2009). Makarem problematises the notion of 'indigenous ways of being' (2009). This reflects the complex account of the modern epistemology of sexuality previously discussed (Foucault, 1979: 43), which creates space for indigenous LGBTQ+ movements, subverting Massad's authenticity/inauthenticity binary.

Crucially, in advocating for Arab rights-based anti-imperialist activities, and discussing its indigenous roots, Helem undermines Massad's accusations (Makarem, 2009; 2011). This can be understood as a counter-hegemonic war of position, overcoming this criticism in a similar way to Mashrou' Leila.

The group builds alliances advocating 'against imperialism and war' (Makarem, 2009: 107–09), directly opposing Western interests and creating a 'wider struggle for change and against imperialism' (2009: 110). This includes solidarity with Arab rights movements in opposition to US occupations and wars in the Arab world; 'anti-imperialist' stances including the 'adoption of an anti-sectarian, anti-racist, and anti-xenophobic position' (Makarem, 2011: 105). By boycotting the 2006 OutGames, Helem participated in Palestinian rights advocacy through the donation of space, resources and volunteers to humanitarian relief efforts to assist Palestinian refugees (Helem, 2006). Boycotting Jerusalem World Pride that same year demonstrated Helem's advocacy for pan-Arab issues alongside its LGBTQ+ advocacy (Makarem, 2011: 108). This is similar to Mashrou' Leila's support for the BDS movement. By building alliances with other Arab rights groups and advocating for other Arab rights interests that explicitly oppose Western interests, these advocates challenge their association by international and local

discourses with Western imperialism as 'agents of the West,' (Makarem, 2009). In this, the potential for wider social change becomes more plausible.

Helem is 'caught between neo-colonial agendas on the one hand, and regressive, oppressive local governments on the other' (Helem, 2006). By 'refusing both options', the group creates a war of position, creating possibilities for cultural change, in terms of an indigenous homosexual identity and more widely a pro-LGBTQ+ Arab identity (Helem, 2006).

In both the Lebanese and Egyptian cases, the apparent opposition between Arab and LGBTQ+ identity is reconciled through alliance-building with other regional rights movements against Western interests. A sub-culture is formed, creating a war of position that fundamentally challenges hegemonic culture.

Conclusions

The recent emergence of sexual politics as a site of political domination lies in State socio-economic weaknesses, including financial and political crises. The State is able to assert itself in this context through persecuting LGBTQ+ people, much of the time using laws left over from colonial regimes (HRW, 2018: 6). State persecution is justified as the affirmation of national difference from former-colonisers, and the maintenance of hegemony. Crackdowns are 'a direct result of the colonial project' (Abdulhadi, 2009: 471). Additionally, critics of ILGBTQ+ groups' advocacy exacerbate orientalist understandings of LGBTQ+ rights as inherently foreign to the region. These discourses converge to present LGBTQ+ and Arab cultural identity as permanently, inherently opposed.

The LGBTQ+ advocates discussed in this text position themselves apart from both discourses. This strategy legitimises their indigenous position, fundamentally challenging hegemonic anti-LGBTQ+ discourse through a cultural war of position, largely through alliance-building. The Egyptian case exemplifies the legal persecution and social discourses repressing LGBTQ+ advocates, and their ability to create a war of position by presenting themselves as indigenous actors. Lebanese alliance-building against Western interests with Arab rights groups demonstrates the ability of LGBTQ+ groups to challenge their association with colonial interests.

The success of local LGBTQ+ advocates will continue to be affected by their ability to disrupt the association of their activities with narratives of 'nationalist and imperial domination' (Puar and Rai, 2002: 130). Regional LGBTQ+ advocacy groups should continue their work by advocating for the wider Arab rights struggles through alliance-building and opposing Western colonial interests.

This research has shown that the chosen critical framework is useful for analysing modern IR events. Further analysis should explore the role of globalisation and the internet in the formation of globalised sexual politics and identity, as well as the implications of financial crises on sexual politics in the region. The key normative question of defining what the alternative routes are available to LGBTQ+ advocates in the region who wish to eliminate existing oppressive laws should also be examined by further research.

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References

Literature sources

Abdulhadi, R. (2009), 'Sexualities and the social order in Arab and Muslim Countries', in Habib, S. (ed.), *Islam and Homosexuality*, Santa Barbara: Praeger, pp. 463–87

AbuKhalil, A. (1993), 'A note on the study of homosexuality in the Arab/Islamic civilization', *Arab Studies Journal*, 1 (2), 32–34

Altman, D. (2004), 'Sexuality and globalisation', *Agenda: Empowering Women for Gender Equity*, 64, 22–28

Boswell, J. (1980), *Christianity, Social Tolerance, and Homosexuality*, Chicago: University of Chicago Press

Chatterjee, P. (1993), *The Nation and its Fragments: Colonial and postcolonial histories*, Princeton: Princeton University Press

Foucault, M. (1979), *The History of Sexuality: An introduction*, London: Penguin Books

Gramsci, A. (1988), *A Gramsci Reader: Selected writings 1916–1935,* London: Lawrence and Wishart

Gramsci, A. (2007), *Prison Notebooks, Volume 3,* New York: Columbia University Press

Habib, S. (2009), *Islam and Homosexuality,* Santa Barbara: Praeger

Hall, S. (2016), *Cultural Studies 1983: A theoretical history*, Durham: Duke University Press

Hebdige, D. (2003), *Subculture: The meaning of style*, London: Routledge

Huntington, S. (2011), *The Clash of Civilizations and the Remaking of World Order,* New York: Simon and Schuster

Khan, B. (2009), 'Longing, not belonging, and living in fear', in Habib, S. (ed.), *Islam and Homosexuality*, Santa Barbara: Praeger, pp. 23–36

Makarem, G. (2009), 'We are not agents of the West: Ghassan Makarem replies to Joseph Massad', available at https://www.resetdoc.org/story/we-are-not-agents-of-the-west/, accessed 6 February 2019

Makarem, G. (2011), 'The story of HELEM', *Journal of Middle East Women's Studies,* 7 (3), 98–112

Massad, J. (2002), 'Re-orienting desire: The Gay International and the Arab world', *Public Culture,* 14 (2), 361–385

Massad, J. (2009a), 'The West and the orientalism of sexuality', available at https://www.resetdoc.org/story/the-west-and-the-orientalism-of-sexuality/, accessed 12 March 2019

Massad, J. (2009b), 'I criticize Gay Internationalists, not gays: Joseph Massad counter-replies to Ghassan Makarem', available at https://www.resetdoc.org/story/i-criticize-

gay-internationalists-not-gays/, accessed 29 January 2019

Parker, A. (1992), *Nationalisms & Sexualities*, New York: Routledge

Pratt, N. (2007), 'The Queen Boat case in Egypt: Sexuality, national security and state sovereignty', *Review of International Studies,* 33 (1), 129-44

Puar, J. K. (2007), *Terrorist Assemblages: Homonationalism in Queer Times,* Durham: Duke University Press

Puar, J. K. and A. S. Rai (2002), 'Monster, terrorist, fag: The War on Terrorism and the production of docile patriots', *Social Text,* 20 (3), 117–48

Saïd, E. (1978), *Orientalism*, London: Routledge

Spivak, G. C. (1998), 'Can the subaltern speak?', in Williams, P. and L. Chrisman, (eds.), *Colonial Discourse and Postcolonial Theory: A reader*, New York: Columbia University Press

Primary sources

Arab Foundation for Freedom and Equality (AFE) (2015), 'Good habits for online safety', available at http://afemena.org/2015/08/03/at-50-center-for-the-education-of-women-celebrates-a-wider-mission/, accessed 14 March 2019

Arab Foundation for Freedom and Equality (AFE) (2017), 'Statement: Human rights and freedom of expression in Egypt – Trapped between security services and the media', available at https://www.afemena.org/statement-human-rights-and-freedom-of-expression-in-egypt-trapped-between-security-services-and-the-media/, accessed 16 March 2020

Attitude Magazine (2019), 'Mashrou' Leila frontman Hamed Sinno on LGBT lessons row', available at https://attitude.co.uk/article/mashrou-leila-frontman-hamed-sinno-on-lgbt-lessons-row-there-are-schools-of-islam-that-are-ok-with-being-gay-1/20613/, accessed 3 April 2019

CBS News (2016), 'Hamed Sinno: Gay, Arab musician tackles inequality, marginalization and Orlando shooting', available at https://www.youtube.com/watch?

v=DAl4cN7CK8E, accessed 3 April 2019

Egyptian Streets (2017), 'Mashrou Leila banned from performing in Egypt over 'rainbow flag': syndicate', available at https://egyptianstreets.com/2017/09/25/the-syndicate-of-musical-professions-bans-mashrou-leila-from-performing-in-egypt-again/, accessed 6 February 2019

Helem (2006), 'Helem at Montreal OutGames 2006', available at https://www.youtube.com/watch?v=mg8i0C4hwBk, accessed 1 April 2019

Human Rights Watch (HRW) (2017), 'Egypt: Mass arrests amid LGBT media blackout', available at https://www.hrw.org/news/2017/10/06/egypt-mass-arrests-amid-lgbt-media-blackout, accessed 1 April 2019

Human Rights Watch (HRW) (2018), *Audacity and Adversity: LGBT activism in the Middle East and North Africa,* New York: Human Rights Watch

Human Rights Watch (HRW) (2019), 'Lebanon: No justification for LGBT crackdown', available at https://www.hrw.org/news/2019/02/11/lebanon-no-justification-lgbt-crackdown, accessed 12 February 2020

Issa, A. (2016), 'How gay rights advance democracy in the Middle East', available at https://foreignpolicy.com/2016/07/22/how-gay-rights-advance-democracy-in-the-middle-east/, accessed 6 February 2019

Reuters (2017), 'Egypt arrests dozens in crackdown on gays', available at https://www.reuters.com/article/us-egypt-rights/egypt-arrests-dozens-in-crackdown-on-gays-idUSKCN1C72BW, accessed 18 February 2019

SMEX News (2019a), 'Statement: Block of Grindr app in Lebanon', available at https://smex.org/statement-block-of-grindr-app-in-lebanon/, accessed 16 March 2019

SMEX News (2019b), 'Lebanon protests: Tips for safely documenting human rights violations', available at https://smex.org/lebanon-protests-tips-for-safely-documenting-human-rights-violations/, accessed 12 December 2019

The Electronic Intifada (2012), 'Lebanon's Mashrou' Leila cancels on Chili Peppers after latter refuses Israel boycott call', available at https://electronicintifada.net/blogs/ali-

abunimah/lebanons-mashrou-leila-cancels-chili-peppers-after-latter-refuses-israel-boycott, accessed 13 December 2019

The New Arab (2017), 'Mashrou' Leila banned from performing in Jordan...yet again', available at https://www.alaraby.co.uk/english/society/2017/6/13/mashrou-leila-banned-from-performing-in-jordan-yet-again, accessed 6 February 2019

The New York Times (2017), 'A Lebanese rocker caught in a human rights incident over rainbow flags', available at https://www.nytimes.com/2017/11/10/style/hamed-sinno-mashrou-leila-gay-rainbow-flags.html, accessed 18 February 2019

World Bank Group (2019), 'World Bank Group to extend current strategy in Egypt to maintain momentum on reforms', available at https://www.worldbank.org/en/news/press-release/2019/04/30/world-bank-group-to-extend-current-strategy-in-egypt-to-maintain-momentum-on-reforms, accessed 21 April 2020

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Constructivism and Determinism: An examination of two conflicting philosophies to voice feminisation for transgender women

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Abstract

A review of various approaches to voice feminisation for transgender women reveals two conflicting philosophies concerning voice and gender identity: determinism and constructivism. While the determinist philosophy equates sex with gender and posits that physiology determines vocal output, the constructivist philosophy views gender and vocal differences as more dependent on socio-cultural factors. Much of past research has relied on the deterministic perspective to define the voice as a set of masculine or feminine acoustic measures. This binary categorisation poses a challenge for adult transgender women who must overcome significant laryngeal changes attributed to puberty to modify their voices. Certain studies indicate voice feminisation interventions are more effective when they incorporate the self-perceived identities of transgender women into treatment strategies instead of relying solely on acoustic voice measures to label a voice as either masculine or feminine. Further research suggests that social factors – including class, ethnicity and upbringing – impact vocalisation. In light of this evidence, this paper acknowledges the need for more holistic treatments of the voice through a better integration of the constructivist perspective into voice feminisation practices. In certain reports of patient outcomes, transgender women who rate their voice as more feminine are also perceived as such by listeners. This finding demonstrates the efficacy of a patient-centred approach, which is best accomplished through a synergistic application of both determinist and constructivist philosophies to voice modification. By doing so, therapeutic interventions will likely be more effective at alleviating incongruences between the voice and self-identity for transgender women.

Keywords: Transgender voice, identity construction, voice alteration, voice feminisation, voice and identity, gender identity

Perceptions concerning the human voice: Determinism and constructivism

The ability to communicate verbally is a unique quality of humankind. For this reason, a person's vocal output is an integral component of their own identity formation. However, discrepancies between self-identity and vocal output contribute to the incidence of gender dysphoria, or the 'distress that may accompany the incongruences between one's experienced or expressed gender and one's assigned gender' (APA, 2013). Therefore, the voice has become a centre of interest in transgender studies, particularly for those attempting a masculine-to-feminine (transfeminine) voice shift who must overcome endocrinological barriers to vocalisation (Hari Kumar *et al.*, 2016: 591; Safer and Tangpricha, 2019: 2453). Generally, two modes of thought exist concerning the connection between the human voice and transgender identity: determinism and constructivism (Zimman, 2018: 1–6). The deterministic philosophy equates sex with gender and consequently relies on physiology to characterise an individual's voice; in contrast, the constructivist philosophy distances itself from the biological perspective by acknowledging socio-cultural influences on both gender and voice (Zimman, 2018: 2–3). While different in their approaches, these two philosophies both attempt to provide large-scale theoretical models for the alignment of voice and self-identity.

It is worth acknowledging that in addition to transgender women, people of other genders exist who may also wish to undergo voice feminisation, such as those who identify as non-binary, genderfluid, genderqueer and so on. While examinations of therapeutic strategies for these identities is of importance, the claims in this paper are primarily based on evidence tied to individuals presumed male at birth (PMAB) who currently identify as transgender women. The purpose of this paper is two-fold: firstly to consider the efficacy of determinist and constructivist philosophies in voice feminisation strategies, and secondly – through an analysis of patient outcomes and empirical data – determine how to better apply these philosophies in clinical practice moving forwards. The effectiveness of these two different philosophies will be based upon a consideration of a treatment's ability to produce tangible changes to vocal output, alter listener perceptions and improve patient-reported satisfaction. Because difficulties with gender-role identity have been attributed to higher rates of suicide attempts (D'Augelli *et al.*, 2005; Maguen and Shipherd, 2010: 35; Remafedi *et al.*, 1991, 1998; Wichstrom and

Hegna, 2003), an examination of these opposing approaches for voice modification is of clinical importance, and employing the right strategies in future clinical settings has the potential to improve the quality of life for members of this particularly vulnerable population.

The physiology of the voice: Understanding its components

Before exploring the contrast between determinist and constructivist approaches to voice feminisation, it is necessary to understand the underlying physiology of the voice. Vocal output is determined by a complex network of neurological, respiratory and muscular systems working in coordination (Hari Kumar *et al.*, 2016: 590–91). Through this system, the larynx produces sound through vibrations of the vocal folds, and the rate of these vibrations – or fundamental frequency – affects voice pitch, with a higher frequency resulting in a higher-pitched voice (Hari Kumar *et al.*, 2016: 591). However, the larynx is dynamic through its ability to alter its shape and lumen (Hari Kumar *et al.*, 2016: 591). As a result, one person is capable of producing a range of vocal outputs.

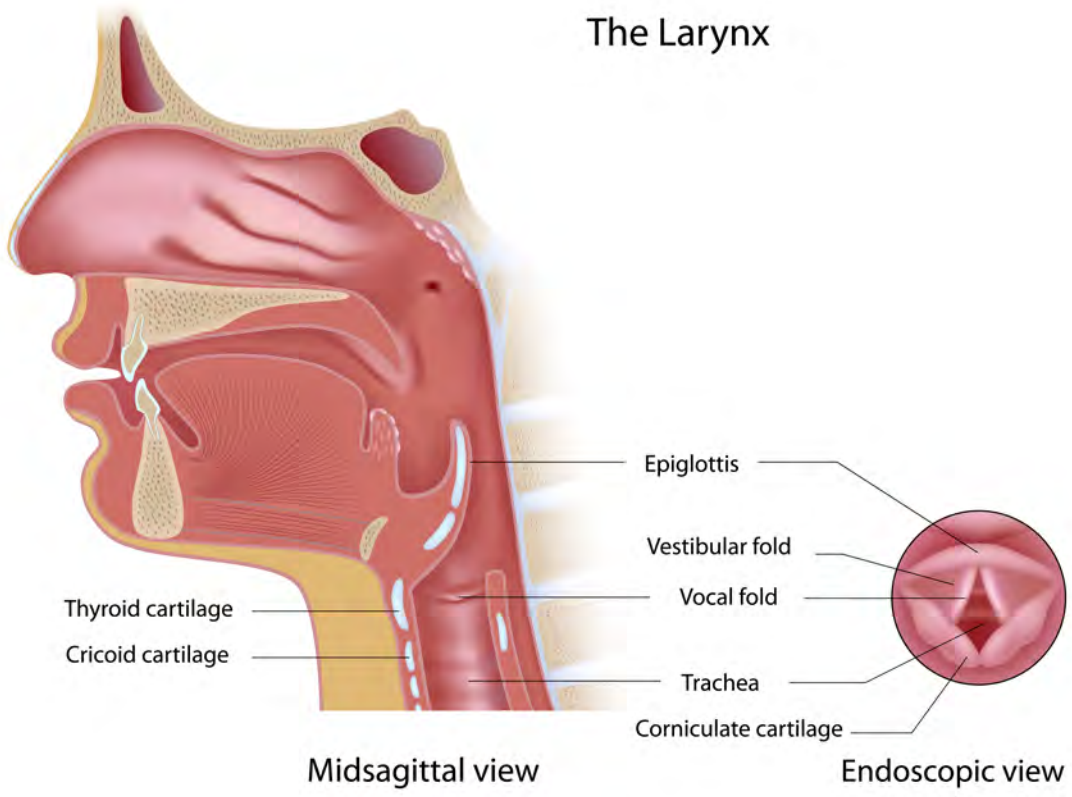

Figure 1: Illustration of basic laryngeal structures. Shutterstock.

Furthermore, pubescent hormones have marked effects on laryngeal shape and structure. Increased testosterone levels in pubescent males thicken the larynx, causing the well-known voice drop that they typically experience (Hari Kumar *et al.*, 2016: 591). In contrast, heightened levels of oestrogen and progestogens in pubescent females have minimal effects on the larynx (Hari Kumar *et al.*, 2016: 591); therefore, testosterone levels seem to be the primary factor in determining vocal differences between the biological sexes.

These physiological differences between the male and female voice present unique challenges for transgender individuals hoping to change the way in which they vocally present themselves. Since the effects of testosterone are not readily reversible, the transfeminine voice transition presents a complicated scenario in which the physiology of the voice must be carefully navigated. While transgender men have access to predominant treatments such as testosterone therapy (Ziegler *et al.*, 2016: 25), transgender women do not have this option, adding an additional layer of difficulty to

their therapeutic approaches. For this reason, research into the transfeminine voice transition presents an exciting opportunity to test hypotheses concerning the connections between gender identity and voice (Zimman, 2018: 11).

The voice feminisation process: Clinical approaches

Because past understandings about the voice have been based primarily on anatomical differences, much of the data regarding the transfeminine voice transition relies heavily on the deterministic perspective. As a result, biological descriptors have become the primary method of classification for differences between masculine and feminine voices (Zimman, 2018: 3). Through this perspective, differences between sex and gender are not readily distinguished. Consequently, researchers who adopt this approach may sometimes rely on their own perceptions and assumptions about the body when classifying the gender identities of participants, even if they do not fully align with a transgender client's wishes (Zimman, 2018: 3).

One common clinical approach involves exogenous oestrogen therapies to help alter secondary sex characteristics. However, because the effects of testosterone primarily occur during puberty (Hari Kumar *et al.*, 2016: 591), post-pubertal oestrogen therapies are unable to induce significant vocal changes (Quinn and Swain, 2018: 1–2). This reality is increasingly complicated by the fact that a large percentage of individuals experiencing gender incongruence do not report so until late adolescence or adulthood (Rider *et al.*, 2018; Safer and Tangpricha, 2019: 2452), which is a likely explanation for the lower rates of vocal satisfaction after hormone therapy for individuals in this older age range (Oates and Dacakis, 2015; Van Damme *et al.*, 2017).

For those seeking alternatives to oestrogen therapy, a number of clinical options for voice modification still exist through the route of phonosurgery. Vocal fold-shortening procedures, such as anterior glottic web formation and cricothyroid approximation, are available to increase a voice's fundamental frequency (Van Damme *et al.*, 2017: 244.e1). While phonosurgery can be effective in accomplishing its goal of raising a voice's pitch, current surgical interventions cannot account for other aspects of the voice such as 'airflow, resonance or formant ranges, intonation, and intensity' (Gray and Courey, 2019: 714). Furthermore, these procedures are unable to address non-verbal communication standards that may vary depending on one's cultural background and

environment (Gray and Courey, 2019: 714). Essentially, phonosurgery reduces the voice's gender identity to its pitch. Therefore, this approach epitomises the determinist assertion that physiology dictates vocal output.

In contrast to phonosurgery, less invasive alternatives are offered through voice therapy. Individuals seeking this route of voice feminisation may also discover a heavy reliance on the determinist perspective since acoustic measures for cis-male and cis-female voices often dictate therapeutic strategies. For example, early literature suggests that average fundamental frequencies must settle around 155 Hz for connected speech (Gelfer and Schofield, 2000; Wolfe *et al.*, 1990) and up to 180 Hz for vowels (Gorham-Rowan and Morris, 2006) in order for a client's voice to fit inside preconceived boundaries of a feminine voice. Furthermore, cis-female voices have been described to have a 'breathiness' that results from friction between vocal folds that do not close completely (Van Borsel *et al.*, 2009: 291). In addition to these factors, other potential sex-distinguishable measures include intonation (Fitzsimons *et al.*, 2001; Owen and Hancock, 2010), intensity (Mészáros *et al.*, 2005), articulation (Mészáros *et al.*, 2005) and inflection (Owen, 2009; Owen and Hancock, 2010). While much of this literature serves to make distinctions concerning voice perception, the data typically stems from a primarily white patient population under traditional Western notions of gender normativity (Stryker, 2014: 15; Zimman, 2018: 2, 7). As a result, these measures have inherent levels of bias, which immediately reveal their shortcomings when trying to apply them more broadly to understand the alignment of voice and gender identity.

While myriad acoustic measures describe the quality of the human voice, most voice therapies have centred on fundamental frequency and resonance. Frequency is altered by vibration speed of the vocal folds, and resonance is the result of 'rounding or retracting the lips and changing the place and extent that the vocal tract is constricted' (Hancock and Garabedian, 2013: 55–56). Concentrating on these two factors has been deemed the most effective technique for altering the perceived quality of the voice (Gelfer and Mikos, 2005; Hillenbrand and Clark, 2009). Certain therapeutic interventions are accomplished through systematic exercises that target aspects of laryngeal muscle tension, and through this method, deterministic goals for transfeminine voice transitions have proven to be effective in achieving their primary purpose: raising a voice's fundamental frequency (Gelfer and Tice, 2013; Gelfer and Van Dong, 2013; Mészáros *et al.*, 2005; Quinn and Swain, 2018: 3). However, there is a need to further explore the clinical

significance of this approach since fundamental frequency alone does not account for every factor impacting someone's voice quality.

Patient outcomes: Is the determinist approach enough?

Looking at patient outcomes in determinist voice interventions reveals important insight regarding the effectiveness of these clinical approaches for voice feminisation. Focusing solely on increasing fundamental frequency is not sufficient for clients to be consistently perceived as feminine because no consensus exists around a frequency level that can be decisively deemed as feminine in all cases (Dacakis *et al.*, 2012: 165–66). Although interventions may produce higher fundamental frequencies, there is significant individual variation, and some results may not be significant enough for clients to be perceived as feminine by listeners (Oates and Dacakis, 2015; Quinn and Swain, 2018: 11). One can also turn to patient-reported treatment effectiveness and satisfaction for an indication of whether or not clinical approaches are truly improving patient quality of life. Whether voice transition interventions are surgical or therapeutic, there is some indication that long-term maintenance of higher fundamental frequencies can be maintained (Dacakis, 2000: 550–51). However, there is a need for more data regarding the long-term efficacy of these interventions (Dacakis, 2000: 550–51; Gray and Courey, 2019: 715–19). Despite this lack of evidence, short-term data presented through the Trans Woman Voice Questionnaire (TWVQ) – previously known as Transsexual Voice QuestionnaireMtF – also provides some insight into the effectiveness of voice therapy interventions.

The TWVQ essentially measures an individual's perception of their own voice. This assessment tool also analyses how participants are able to integrate their voice into everyday life, and its reliability has been supported by a high level of consistency across studies (Cardell and Ruda, 2014; Dacakis *et al.*, 2013, 2017: 835–37; Davies and Johnston, 2015; Santos *et al.*, 2015). In one such study, a strong correlation was discovered between the TWVQ scores of 148 transgender women and self-reported perceptions of their voice's level of femininity (Dacakis *et al.*, 2017: 833–37). In contrast, no such correlation was proven to be significant between TWVQ scores and acoustic voice characteristics such as frequency and voice quality (Dacakis *et al.*, 2017: 835–37). In other words, the self-perception of these transgender women is a more important indicator for the alignment of their voices and identities than deterministic measures that qualify their

voices as simply male or female. This evidence provides strong support to the idea that an overemphasis on the acoustic parameters of the voice does not always help clients settle at a voice that fits their gender identity. As a result, this limited deterministic approach is unable to address issues tied to gender dysphoria in every case.

Additional research findings posit that a more holistic perspective must be applied to transfeminine voice transitions. Empirical data demonstrate that clients' self-perceived vocal femininity is the strongest correlate for voice satisfaction (Quinn and Swain, 2018: 4). This claim illustrates that aligning voice and gender identity involves more than just acoustic measures and suggests that additional factors – such as those considered by the constructivist philosophy – also contribute to one's overall voice experience (Dacakis *et al.*, 2012: 166–69).

Intersectionality of the voice: Integrating the constructivist mindset

The constructivist perspective offers a potential counterbalance to the physiologically focused determinist point of view. Instead of relying entirely upon anatomy, the constructivist philosophy acknowledges that voice and gender differences are partially – if not entirely – the result of social constructs (Azul and Hancock, 2020: 8–9). Furthermore, constructivism defines the speaker's 'vocal behavior' as an important factor contributing to a person's vocal identity (Azul and Hancock, 2020: 8–9). Integrating the constructivist mindset of voice and gender identity in clinical practice may overcome limitations imposed by determinism's binary perspective. An examination of past research and additional patient outcomes related to the constructivist philosophy will evaluate the validity of this approach for voice feminisation practices.

Studies involving the voice of pre-pubertal children provide interesting support for the application of the constructivist perspective to clinical practice. Although considerable differences exist among their fundamental frequencies, children's vocal tracts do not differ substantially enough on their own to account for such a vast degree of variation; therefore, researchers attribute these differences to the processes of language acquisition and socialisation (Zimman, 2018: 5). This evidence suggests that children may be able to exert even more control over their voices than originally thought. This type of control owes itself to a child's ability to settle at varying frequencies depending on how they

choose to manipulate their voice (Zimman, 2018: 6). Over time, their vocal tracts may end up shorter or longer than they would otherwise be without conscious manipulation (Zimman, 2018: 6), suggesting that socialisation plays a role in the formation of someone's voice and even has the capacity to affect physiology. This evidence indicates that vocal output is more malleable than traditionally thought. Indeed, the human voice has a variety of ranges that can be attributed to one person; yet the formative processes during one's youth may determine the range at which this individual's voice settles. These facts coincide with the sentiments of some in the trans community who have expressed a belief that 'genital configurations don't undermine facts about who [they] are' (Bettcher, 2014: 385–389). To truly adopt this viewpoint into clinical practice, even further emphasis must be placed on aiding transgender women from a young age – or as soon as possible – to ensure that they are in social situations in which they feel comfortable altering their voice to fit their self-perceived identity.

The reported impacts of socialisation on vocal output further suggest the benefits of a constructivist mindset. Stuart-Smith (2007) found that vocal differences combine with socio-economic status among young cisgender women in Glasgow. Specifically, young working-class women produced a lower frequency /s/ more similar to that of cisgender men; meanwhile, middle-class women aligned more closely with the general population of cisgender women (Stuart-Smith, 2007). Additionally, ethnicity has its own connection to the voice. For instance, Japanese-speaking cisgender women have been shown to have higher fundamental frequencies on average than their American English-speaking counterparts, and the opposite is true when comparing Japanese and American cisgender men (Loveday, 1981; Yuasa, 2008). In another study that examined seven primarily indigenous languages, only one of these languages (Chickasaw) demonstrated significant differences between male and female /s/ frequencies (Gordon *et al.*, 2002). These findings demonstrate the socio-cultural influences on the human voice. By being encouraged to see this perspective, those wishing to undergo voice feminisation may feel more comfortable in understanding that their vocal output is determined by a litany of factors. As a result, transgender women may be more at ease even if they cannot fully pass into a more feminine vocal range as defined by a set of one-dimensional physiological parameters.

Client comments regarding the voice modification goals promoted in the Pacific University Transgender Voice Program provide some insight into the usefulness of

constructivism in clinical practice. This programme employs approaches that target fundamental frequency and resonance, with clients choosing for themselves whether or not to aim for a passing grade. In R. Bourland's video posted by Pacific University (2019), Lana Zeitler – one of the programme's clients – reveals that there is some debate in the trans community about the importance of passing. She expresses her contentment with 'being in the middle' because it frees her from the added pressure of feeling as if she must absolutely pass the test in order to reform her identity. Her opinion echoes the sentiments of some transgender scholars, such as Sandy Stone, who criticise the concept of passing because it inherently suggests that transgender individuals must present themselves as either masculine or feminine and not anything between (1991: 294–96). This perspective clearly outlines the importance of gender malleability. Based on Zeitler's words and the reported results of the TWVQ mentioned earlier in this paper, a heavy-handed focus on the voice's acoustic components fails to provide a malleable framework for vocal identity that is capable of accommodating greater diversity in gender identities, and consequently, fewer patients experience satisfaction with their treatments. For this reason, the constructivist approach could prove to be beneficial in voice feminisation therapies because it acknowledges more flexibility to one's vocal output, allowing for a multiplicity of frequency ranges aligning with various identities.

There are some studies that recognise growing support for the utility of constructivism in clinical practice. In an article posted in the *International Journal of Transgenderism*, Davies *et al.* (2015) advocate that speech-language therapists must be sensitive to the client's wishes instead of following overreaching assumptions about a person's goals related to voice and communication. They also claim that understanding the client's own perception of the voice is useful in determining the effectiveness of voice therapy (Davies *et al.*, 2015: 119). Because transgender women who rate their vocal behaviour as more feminine are also perceived as such by listeners (Davies *et al.*, 2015: 122), speaker perceptions – as opposed to that of listeners – should be a top priority for voice feminisation approaches. Many transgender women even feel less pressure to feminise their voice after gender reassignment surgery, suggesting that the need to sound more feminine may be less important if other incongruences between the body and gender identity can be remedied in some way (Davies *et al.*, 2015: 121). Although a single-minded emphasis on physiology has proven to be less effective, this evidence suggests that physiologically focused interventions can still prove useful and should not be ignored. Indeed, determinist and constructivist mindsets may work in harmony if each is

given credence depending on the needs of the client. This harmonious approach is what Azul and Hancock refer to as the 'biocultural assemblage view' of the voice, which they regard as the most 'comprehensive theoretical perspective' (2020: 9). Through this point of view, an overemphasis on either constructivism or determinism is inadequate; instead, it is the combined understanding of both the physiological underpinnings and intersectionality of the human voice that has perhaps the greatest potential to facilitate client satisfaction. If transgender women understand that vocal femininity is tied to sociocultural factors in addition to anatomy, then they will be more empowered to find a voice that truly fits their identity.

Conclusion

The voice is one of many components contributing to someone's gender identity, and within the voice itself are a number of physiological and socio-cultural influences determining vocal output. Evaluating the ability of various treatments to produce tangible changes to vocal output, alter listener perceptions and improve patient-reported satisfaction has demonstrated that a singular focus on physiological factors does not fully address the complex task of voice feminisation for transgender women. However, a complete exclusion of anatomical factors also appears to be inadequate. Therefore, constructivism must be incorporated alongside determinism in clinical practice to comprehensively treat clients according to their needs. Given society's ever-evolving understanding of the relationship between sex and gender, we lack a general consensus concerning the best practical approaches to solve issues related to gender dysphoria. However, it is important to understand that 'practice…precedes evidence' (Davies *et al.*, 2015: 119); therefore, research must continually integrate the constructivist philosophy into voice feminisation approaches that may have previously been only deterministically focused. Employing both of these approaches in a synergistic manner may help a much wider array of transgender women arrive at their desired vocal outcomes and offer greater relief to feelings of gender dysphoria. While this paper has primarily focused on voice feminisation for transgender women, future studies must invest in better understanding voice interventions for those of other gender identities such as transgender men, non-binary, genderfluid, genderqueer and so on. Additionally, further research must extend beyond the scope of a traditionally white Western perspective of vocal identity in order to gain a broader understanding of the 'complex interplay between race, ethnicity and transgender phenomena' (Stryker, 2014: 15). Expanding our

understanding of voice identification across varying ethnic groups could yield useful information concerning the broader connections between the alignment of one's voice and gender identity.

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List of illustrations

Figure 1: Illustration of basic laryngeal structures. Image produced by Alila Medical Media but licensed and obtained through Shutterstock.

References

American Psychiatric Association (2013), *Diagnostic and Statistical Manual of Mental Disorders V*, Arlington: American Psychiatric Publishing (originally published in 1952)

Azul, D. and A. B. Hancock (2020), 'Who or what has the capacity to influence voice production? Development of a transdisciplinary theoretical approach to clinical practice addressing voice and the communication of speaker socio-cultural positioning', *International Journal of Speech-Language Pathology*, 1–12 https://doi.org/10.1080/17549507.2019.1709544

Bettcher, T. M. (2014), 'Trapped in the wrong theory: Rethinking trans oppression and resistance', *Signs*, 39 (2), 383–406 https://doi.org/10.1086/673088

Bourland, R. (2019), 'Pacific University Transgender Program', available at https://youtu.be/z3_kvPR1Uzc, accessed 13 February 2020

Cardell, F. and M. Ruda (2014), 'Reliability evaluation of the Swedish version of Transsexual Voice QuestionnaireMale-to-Female (TVQMtF)', unpublished master's thesis, Karolinska Institute

D'Augelli, A. R., A. H. Grossman, N. P. Salter, J. J. Vasey, M. T. Starks and K. O. Sinclair (2005), 'Predicting the suicide attempts of lesbian, gay, and bisexual youth', *Suicide and Life Threatening Behavior*, 35 (6), 646–60

Dacakis, G. (2000), 'Long-term maintenance of fundamental frequency increases in male-to female transsexuals', *Journal of Voice*, 14 (4), 549–56

Dacakis, G., S. Davies, J. Oates, J. M. Douglas and J. R. Johnston (2013), 'Development and preliminary evaluation of the Transsexual Voice Questionnaire for male-to-female transsexuals', *Journal of Voice*, 27 (3), 312–20

Dacakis, G., J. Oates and J. Douglas (2012), 'Beyond voice: perceptions of gender in male-to-female transsexuals', *Current Opinion in Otolaryngology & Head and Neck Surgery*, 20 (3), 165–70 https://doi.org/10.1097/MOO.0b013e3283530f85

Dacakis, G., J Oates and J. Douglas (2017), 'Associations between the Transsexual Voice Questionnaire (TVQMtF) and self-report of voice femininity and acoustic voice measures', *International Journal of Language & Communication Disorders*, 52 (6), 831–38 https://doi.org/10.1111/1460-6984.12319

Davies, S. and J. R. Johnston (2015), 'Exploring the validity of the Transsexual Voice Questionnaire for male-to-female transsexuals', *Canadian Journal of Speech-Language Pathology and Audiology*, 39 (1), 40–51

Davies, S., V. G. Papp and C. Antoni (2015), 'Voice and communication change for gender nonconforming individuals: Giving voice to the person inside', *International Journal of Transgenderism*, 16 (3), 117–59 https://doi.org/10.1080/15532739.2015.1075931

Fitzsimons, M., N. Sheahan and H. Staunton (2001), 'Gender and the integration of acoustic dimensions of prosody: Implications for clinical studies', *Brain and Language*, 78 (1), pp. 94–108

Gelfer, M. P. and V. A. Mikos (2005), 'The relative contributions of speaking fundamental frequencies to gender identification based on isolated vowels', *Journal of Voice*, 19, 544–54

Gelfer, M. P. and K. J. Schofield (2000), 'Comparison of acoustic and perceptual measures of voice in MtF transsexuals perceived as female versus those perceived as males',

Journal of Voice, 14 (1), 22–33

Gelfer, M. P. and R. M. Tice (2013), 'Perceptual and acoustic outcomes of voice therapy for male-to-female transgender individuals immediately after therapy and 15 months later', *Journal of Voice*, 27 (3), 335–347

Gelfer, M. P. and B. R. Van Dong (2013), 'A preliminary study on the use of vocal function exercises to improve voice in male-to-female transgender clients', *Journal of Voice*, 27 (3), 321–34 http://dx.doi.org/10.1016/j.jvoice.2012.07.008

Gordon, M., P. Barthmaier and K. Sands (2002), 'A cross-linguistic acoustic study of voiceless fricatives', *Journal of the International Phonetic Association*, 32 (2), 141–74 https:// doi.org/10.1017/S0025100302001020

Gorham-Rowan, M. and R. Morris (2006), 'Aerodynamic analysis of male-to-female transgender voice', *Journal of Voice*, 20 (2), 251–62

Gray, M. L. and M. S. Courey (2019), 'Transgender voice and communication', *Otolaryngologic Clinics of North America*, 52 (4), 713–22

Hancock, A. B. and L. M. Garabedian (2013), 'Transgender voice and communication treatment: A retrospective chart review of 25 cases', *International Journal of Language & Communication Disorders*, 48 (1), 54–65 https://doi.org/10.1111/j.1460-6984.2012.00185.x

Hari Kumar, K. V. S., A. Garg, N. S. Ajai Chandra, S. P. Singh and R. Datta (2016), 'Voice and endocrinology', *Indian Journal of Endocrinology and Metabolism*, 20 (5), 590–94 https://doi.org/10.4103/2230-8210.190523

Hillenbrand, J. M. and M. J. Clark (2009), 'The role of fundamental frequency and formant frequencies in distinguishing the voices of men and women', *Attention, Perception, and Psychophysics*, 71(5), 1150–66

Loveday, L. (1981), 'Pitch, politeness and sexual role: An exploratory investigation into the pitch correlates of English and Japanese politeness formulae', *Language and Speech*, 24 (1), 71–88. https://doi.org/10.1177/002383098102400105

Maguen, S. and J. C. Shipherd (2010), 'Suicide risk among transgender individuals', *Psychology & Sexuality*, 1 (1), 34–43 https:/doi.org10.1080/19419891003634430

Mészáros K, L. C. Vitéz, I. Szabolcs, M. Góth, L. Kovács, Z. Görömbei and T. Hacki (2005), 'Efficacy of conservative voice treatment in male-to-female transsexuals', *Folia Phoniatrica et Logopaedica*, 57(2), 111–18

Oates, J. and G. Dacakis (2015), 'Transgender voice and communcation: Research evidence underpinning voice intervention for male-to-female transsexual women', *Perspectives on Voice and Voice Disorders*, 25 (2), 28–58

Owen, K. (2009), 'Comparing self-perceptions to subjective and objective measures of femininity in transgender speakers', unpublished master's thesis, George Washington University

Owen, K. and A. B. Hancock (2010), 'The role of self- and listener perceptions of femininity in voice therapy', *International Journal of Transgenderism*, 12 (4), 272–84

Quinn, S., and N. Swain (2018), 'Efficacy of intensive voice feminisation therapy in a transgender young offender', *Journal of Communication Disorders*, 72, 1–15 https://doi.org/10.1016/j.jcomdis.2018.02.001

Remafedi, G., J. A. Farrow and R. W. Deisher (1991), 'Risk factors for attempted suicide in gay and bisexual youth', *Pediatrics*, 87 (6), 869–75

Remafedi, G., S. French, C. Story, M. D. Resnick and R. Blum (1998), 'The relationship between suicide risk and sexual orientation: Results of a population-based study', *American Journal of Public Health*, 88 (1), 57–60

Rider, G. N., B. J. McMorris, A. L. Gower, E. Coleman and M. E. Eisenberg (2018), 'Health and care utilization of transgender and gender non-conforming youth: A population-based study', *Pediatrics*, 141 (3), e20171683 https://doi.org/10.1542/peds.2017-1683

Safer, J. D. and V. Tangpricha (2019), 'Care of transgender persons', *New England Journal of Medicine*, 381 (25), 2451–60 https://doi.org/10.1056/NEJMcp1903650

Santos, H., H. Aguiar, A. G, H. E. Baeck and J. Van Borsel (2015), 'Translation and preliminary evaluation of the Brazilian Portuguese version of the Transgender Voice

Questionnaire for male–to–female transsexuals', *Communication Disorders and Sciences*, 27 (1), 89–96

Stone, S. (1991), 'The 'Empire' Strikes Back: A posttranssexual manifesto', in Epstein, J. and K. Straub (eds), *Body Guards: The cultural politics of gender ambiguity*, New York: Routledge, pp. 280–304

Stryker, S. (2014), '(De)subjugated knowledges: an introduction to transgender studies', in Stryker, S. and S. Whittle (eds), *The Transgender Studies Reader*, New York: Routledge Taylor and Francis Group, pp. 1–17

Stuart-Smith, J. (2007), 'Empirical evidence for gendered speech production: /s/ in Glaswegian', in Cole, J. and J. I. Hualde (eds), *Laboratory Phonology* 9, 65–86

Van Borsel, J., J. Janssens, and M. De Bodt (2009), 'Breathiness as a feminine voice characteristic: A perceptual approach', *Journal of Voice*, 23 (3), 291–94

Van Damme, S., M. Cosyns, S. Deman, Z. Van den Eede and J. Van Borsel (2017), 'The effectiveness of pitch-raising surgery in male-to-female transsexuals: A systematic review', *Journal of Voice*, 31 (2), 244.e1-244.e5 https://doi.org/10.1016/j.jvoice.2016.04.002

Wichstrom, L. and K. Hegna (2003), 'Sexual orientation and suicide attempt: A longitudinal study of the general Norwegian adolescent population', *Journal of Abnormal Psychology*, 112 (1), 144–51

Wolfe, V. I., D. L. Ratusnik, F. H. Smith and G. Northrop (1990), 'Intonation and fundamental frequency in male-to-female transsexuals', *Journal of Speech and Hearing Disorders*, 55 (1), 43–50

Yuasa, I. P. (2008), 'Culture and gender of voice pitch: A sociophonetic comparison of the Japanese and Americans', *Language in Society*, 40 (2), 251–52

Ziegler, A., T. Henke, J. Wiedrick and L. B. Helou (2018), 'Effectiveness of testosterone therapy for masculinizing voice in transgender patients: A meta-analytic review', *International Journal of Transgenderism*, 19 (1), 25–45 https:doi.org10.1080/15532739.2017.1411857

Zimman, L. (2018), 'Transgender voices: Insights on identity, embodiment, and the gender of the voice', *Language and Linguistics Compass*, 12 (8), 1–16 https://doi.org/10.1111/lnc3.12284

Glossary

Anterior glottic web formation: Formation of new tissue that narrows portions of the larynx; can raise vocal pitch.

Articulation: The action of placing certain emphases on consonant sounds while speaking.

Cricothyroid approximation: Procedure in which laryngeal muscle tension is altered to raise vocal pitch.

Gender*: Identity within the context of social roles; formed on an individual basis and developed over the course of one's life; independent of biology.

Inflection: changes to pitch or intensity while speaking that imply additional meaning to words or phrases.

Intensity: The loudness of a person's voice while speaking.

Intonation: The variation and combination of vocal tones utilised while speaking.

Lumen: The interior cavity of a tube-like anatomical organ or structure; often utilised for the exchange of liquid, gases and nutrients.

Phonosurgery: Surgical interventions that focus specifically on changes to anatomical structures to impact someone's vocal output. The interior cavity of a tube-like anatomical organ or structure; often utilised for the exchange of liquid, gases and nutrients.

Sex*: Identity within a biological context; based on physiological factors

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Public Perceptions on Using Virtual Reality and Mobile Apps in Anxiety Treatment: A cross sectional analysis

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Abstract

New technologies such as virtual reality (VR) and mobile apps are increasingly being developed and trialled therapeutically to help treat anxiety disorders. Despite this increasing market, there is little research on how the public perceive the incorporation of these innovative technologies in anxiety treatment. This study aimed to describe knowledge, awareness and perceptions of VR and mobile apps for the treatment of anxiety. To do this, a survey was disseminated to those aged 18 to 35 with no current or previous mental illness via social media and poster advertisements, and 57 individuals participated. Results demonstrated that most individuals had limited knowledge on the use of VR and mobile apps in mental health, but overall demonstrated positive perceptions and high optimism regarding its potential use. Neither treatment modality was perceived as being as effective as standard treatment; however, participants were willing to use either modality if recommended by a therapist and use both in conjunction with standard treatment. Participants demonstrated a willingness to use a mobile app as a first point of contact. These findings have implications for the way in which these technologies are rolled out to the public.

Keywords: Virtual reality, VR, mobile apps, anxiety treatment, mental health treatment, public perceptions

Introduction

In 2018, around 4.8 million people in Australia (20 per cent of the population) lived with a mental health condition (Australian Bureau of Statistics (ABS), 2018). In the space of three years between 2015 and 2018, this prevalence had increased by 800,000 people (2.6

per cent of the population), predominantly driven by an 11 per cent rise in anxiety-related disorders – which alone affect 13 per cent of all Australians (ABS, 2018). Those most affected are aged between 18 and 35, when anxiety onset is most common (Lijster *et al.*, 2017). These conditions have a detrimental impact on an individual's quality of life, family and community dynamics, and contribute to both the direct and indirect productivity loss amounting to $56.7 billion annually (The Royal Australian and New Zealand College of Psychiatrists (RANZCP), 2014). Given this extensive and increasing burden, effective treatment options and preventative measures are crucial.

Treatment for anxiety is predominantly one of two types: psychotherapy or pharmaceuticals. One type of psychotherapy, cognitive behavioural therapy (CBT), has significant research support and is currently the 'gold standard' (David *et al.*, 2018) first-line treatment for anxiety (Arch and Craske, 2009). However, meta-analyses and systematic reviews have identified that response rates to CBT for anxiety disorders are as low as 50 per cent (Hofmann *et al.*, 2012; Loerinc *et al.*, 2015). As an alternative to psychotherapy, pharmaceuticals (Donker *et al.*, 2013) are increasingly used and widely available (Farach *et al.*, 2012). However, pharmaceutical response rates are estimated to be only 50–60 per cent, and critically, remission rates are as low as 25–35 per cent (Bystritsky, 2006; Roy–Byrne, 2015). Further, pharmacotherapy is often an insufficient treatment alone (Taylor *et al.,* 2012) and an adjunctive therapy, such as CBT, is often required. Additionally, Australian anxiety sufferers encounter significant barriers to seeking treatment in the first place resulting in up to 73 per cent of those with anxiety symptoms not seeking treatment at all (Harris *et al.*, 2015). One contributor to this is low mental-health literacy, which is a limited ability to recognise and label one's symptoms and beliefs around the progression of symptoms (Jorm, 2000). Low mental-health literacy contributes to a lack of treatment-seeking through misattribution and mislabelling of symptoms and unawareness of the treatment options, suitability and outcomes (Coles and Coleman, 2010). Additionally, both the stigma one perceives from others via societal rejection due to behaviour, appearance or mental illness (Curcio and Corboy, 2020) and internalised self-stigma whereby the individual labels themselves as being unacceptable for experiencing anxiety difficulties (Vogel *et al.*, 2006) additively contribute to a lack of help-seeking (Vogel *et al.*, 2007). Finally, other barriers such as cost impede treatment-seeking, particularly for the proportion of those with comorbid physical or mental illness, or other medical problems (RANZCP, 2015). Thus, there is substantial room for improvement to increase the accessibility of treatments for anxiety sufferers and

improve their effectiveness. This is imperative to address in order to reduce the significant burden anxiety disorders create for individuals and society at large.

Recent developments in virtual reality (VR) technology and increased access to technology such as smartphones are shifting how anxiety disorders are treated (Valmaggia *et al.* 2016). VR and mobile apps are being developed and trialled to treat mental illness (Anderson *et al.*, 2003, Lipschitz *et al.,* 2019). These technological advancements inspire new opportunities for alternative, more accessible and effective treatment platforms. Specifically, VR is often trialled in anxiety disorders (Carl *et al.*, 2019) including, but not limited to, social anxiety disorder (Kampmann *et al.*, 2016) and specific phobias (Cote and Bouchard, 2008). An example of this is VR exposure therapy, whereby the client engages with VR technology and its virtual environment to be systematically introduced to the feared stimulus with the guidance of a mental health professional (Parsons and Rizzo, 2008). Supporting VR's effectiveness, a meta-analysis and systematic review support the use of VR in exposure therapy (Botella *et al.*, 2017), showing large effect sizes compared to control conditions and no difference to the standard modality of in-vivo exposure therapy (Carl *et al.*, 2019). Critically, the therapy conducted within the virtual environment has been shown to generalise to real-life contexts, demonstrating its ecological validity (Morina *et al.*, 2015). One of the significant advantages to VR exposure therapy is that the therapist may elicit exposure to stimuli that would otherwise be unable to be mimicked within the therapist's office (Bouchard *et al.*, 2017). Further, acceptability of exposure therapy is greater for VR modalities than in-vivo (Garcia-Palacios *et al.*, 2007). Partnered with the increasing accessibility (Bouchard *et al.*, 2017), VR reduces issues in accessing and receiving treatment.

Additionally, there are a plethora of mobile apps on the market targeting disorders such as social anxiety (Alyami *et al.*, 2017), general anxiety disorder and others (Sucala *et al.*, 2017). For example, a mobile app targeting social anxiety disorder may take users through a self-help programme structured into modules that each address various challenges and encourage completion of exercises (Stolz *et al.*, 2018). In turn, the mobile app can provide motivational enhancement, guide the user through behavioural experiments and provide relapse prevention strategies for maintaining the skills learnt (Stolz *et al.*, 2018). Despite the estimate that less than 5 per cent of mobile apps on available are rigorously tested (Sucala *et al.*, 2017), a meta-analysis of randomised

control trials for anxiety smartphone interventions revealed that these interventions evoke a significantly greater reduction in anxiety symptoms compared to control conditions (Firth *et al.*, 2017). This suggests that when rigorously tested, mobile apps provide another technological platform of therapy with which anxiety sufferers can engage. Additionally, the pairing of VR and the mobile app platform has successfully delivered a treatment for phobias without therapist intervention in a randomised clinical trial (Donker *et al.*, 2019), further demonstrating the potential of these two modalities in both independent and integrated formats.

Developments in the capabilities of VR and mobile apps open the door to new forms of evidence-based treatment that is more accessible and affordable than other standard treatments. However, while these new technologies have incredible potential, it is unclear how potential users perceive these new modalities of therapy, particularly VR. One study conducted by Keller and colleagues (2017) used Facebook comment content analysis on a video demonstrating VR therapy to gauge the public's perception of VR use within the healthcare sector. Three-quarters of comments (n = 1614, 74.16 per cent) expressed positive perceptions about VR use within the healthcare sector, with 15.56 per cent expressing negative views and 34.70 per cent giving 'neutral' views. Some comments expressed mixed or multiple perceptions. This suggests that those who already engage with technological platforms, such as social media, are optimistic about VR's inclusion in the healthcare sector. However, it is unclear whether firstly, this extends to mental health, secondly, whether this is true for anxiety-related problems and thirdly, whether this is true for 18- to 35-year-olds who are at higher risk of developing an anxiety-related problem (Lijster *et al.*, 2017). If such individuals have limited knowledge or negative perceptions towards treatment, they are less likely to obtain help (Reardon *et al.*, 2017) in the early stages of the illness where intervention is thought to reduce prevalence of developing an anxiety disorder (Osuch *et al.*, 2015, Topper *et al.*, 2017). In conjunction with assuring the effectiveness of these technological treatment modalities themselves, understanding how this age group perceive such modalities is critical to ensure effective implementation into mental healthcare if these individuals do begin to suffer anxiety problems. The aim of this exploratory survey was to describe knowledge, awareness and perceptions of VR and mobile apps for the treatment of anxiety among a sample of 18- to 35-year-olds with no current or previous mental illness. Specifically, for VR and mobile apps uniquely, this study sought to, 1) determine perceived level of effectiveness, 2) determine perceived legitimacy, 3) evaluate respondents' willingness to engage and 4)

understand the perceived comparison to common treatment methods. This research provides insights into how to successfully roll out novel technological platforms for anxiety treatment.

Methods

Participants

To be included within the study, participants had to be aged between 18 and 35 and have no current or previous diagnosis of a mental health disorder. Participants were recruited via advertisements on both the campus and online within the Monash University community and social media advertisements to the general community. The survey was completed on an online Google Forms survey platform.

The study was approved by the Monash University Human Research Ethics Committee (See Appendix B for Ethical Approval Notice).

Distribution

The survey was distributed via social media platforms such as Facebook as well as on a QR code on flyers that were posted around the Monash University Clayton Campus. These methods were chosen to best target the eligible demographic of those aged 18–35. The survey was active for 14 weeks from 8 March 2019 to the 18 June 2019.

Procedure

The survey asked participants to first read the explanatory statement that explained what was involved in the survey, information about confidentiality, possible benefits and risks, and included links and numbers to mental health helplines for participants who experienced any discomfort.

The survey comprised of 3 demographic questions, 2 eligibility questions, 6 multiple-choice questions and 19 Likert-scale questions. These questions were formulated based on the results from preliminary research papers on public perceptions of VR in healthcare (Keller *et al.,* 2017).

The multiple-choice questions assessed participants' current knowledge of the role of VR and mobile apps in the mental health sector. Participants were then presented with a short paragraph of information on the current use of VR and mobile apps in mental health to aid with the next Likert-scale question section. The following sections asked questions regarding the participants' willingness to use these technologies, their perceptions on the effectiveness and legitimacy of these technologies and their perceived barriers and advantages to using such technologies. At the conclusion of the survey, participants were thanked for their time.

Data analysis

Survey responses were analysed using Statistical Package for Social Sciences (SPSS) version 25.0. Data was analysed by running descriptive statistics (frequencies, mean) and inferential statistics to examine relationships between responses. A maximum likelihood ratio Chi-square test (McHugh, 2013) was generated for those who have and have not experienced anxiety symptoms as well as those who are and are not aware of the use of VR and mobile apps in healthcare against perceptions of effectiveness and legitimacy for both VR and mobile apps. Cramer's V indicated the effect size for any significant relationships.

Results

Overview

Respondents were asked three main streams of questions on their perception of VR and mobile apps. These were their legitimacy (that is, their validity as treatment tools), their efficacy and their personal willingness to use such tools. Results broadly demonstrated that individuals tended to be aware that mobile apps and, to a lesser extent, VR are used in healthcare. On a five-point Likert scale, a majority of respondents reported that they perceived VR as being moderately illegitimate, and mobile apps as moderately legitimate. Both VR and mobile apps were seen as moderately effective. Of interest, most participants were optimistic and willing to use the platforms; however, they were more willing to use each technology if recommended by a therapist. Finally, individuals indicated that they would be more likely to engage with either platform in conjunction with medication or psychological therapy as opposed to either platform alone.

Please refer to Appendix A for raw survey output.

Participant characteristics

Participants included 57 individuals (female = 38, male = 19), aged from 18 to 35 (mean = 22). Of these participants, 65 per cent reported having experienced anxiety symptoms at some time in their life since the age of 18 years old, but not having had a diagnosed mental health disorder.

Current knowledge

Participants' current knowledge about VR and mobile apps were assessed prior to any information about the mediums being provided. Responses are detailed in Figures 1a, 1b and 1c.

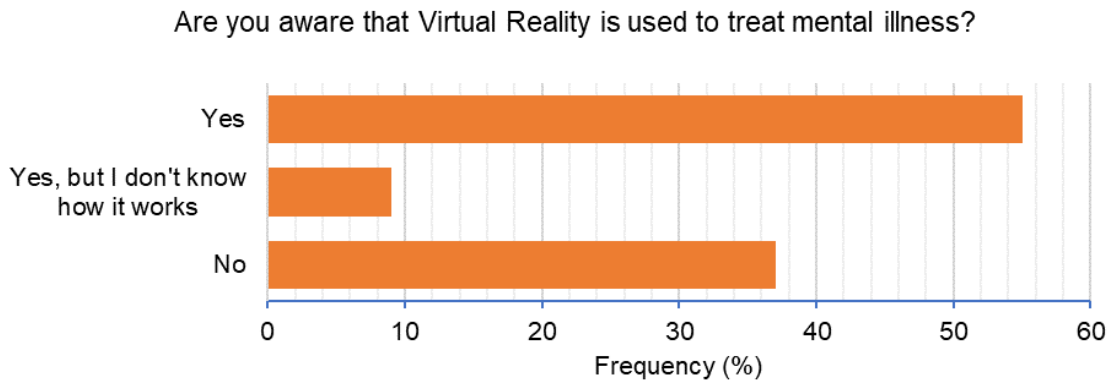

Figure 1a: Awareness of VR in mental illness treatment

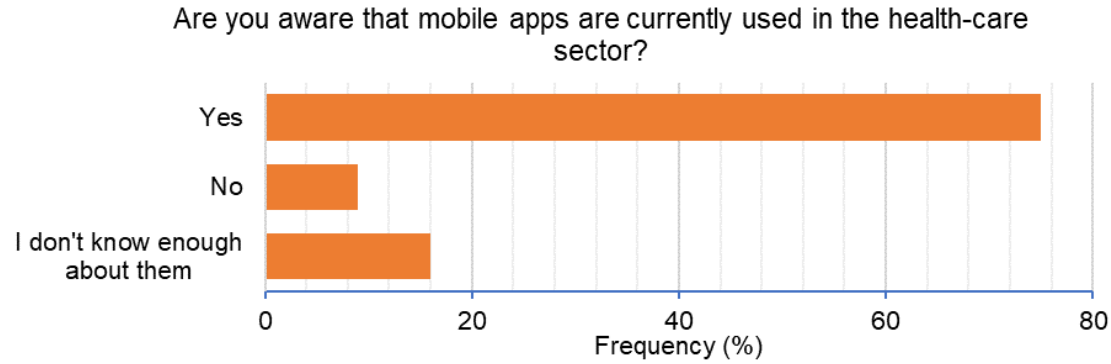

Figure 1b: Awareness of mobile apps in mental illness treatment

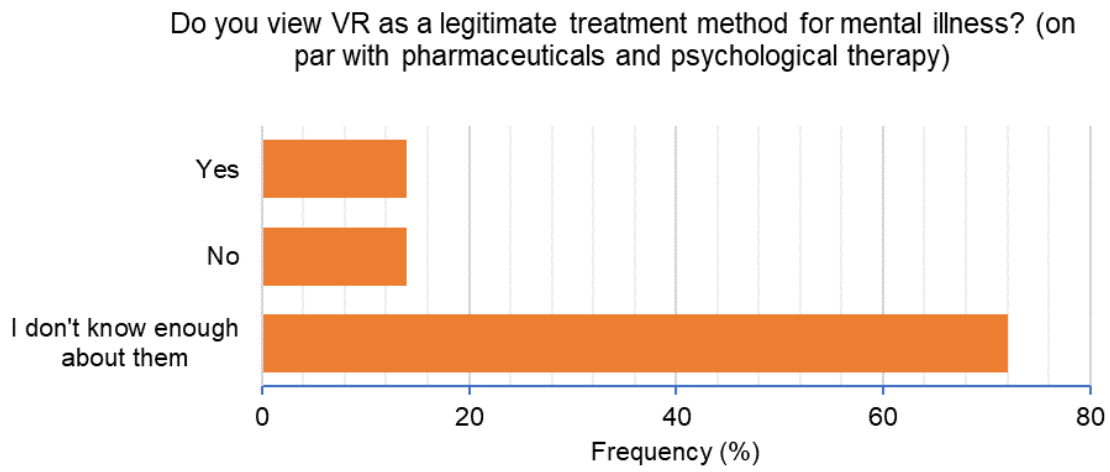

Figure 1c: Perception of VR as a legitimate treatment for mental illness

Additionally, 97 per cent of participants stated that they were interested in the potential uses of technology to help treat mental illness.

Willingness to use

Almost three-quarters (72 per cent) of participants reported that they would want to try VR to treat anxiety and anxiety-related mental illness; 23 per cent felt that they do not know enough about it to respond otherwise. An 86 per cent majority responded that they would suggest or inform someone they knew about VR or mobile apps if that person had anxiety symptoms.

Questions following a short information paragraph

Questions for the following sections were answered on a Likert scale ranging from a rating of 1 to 6 with response meanings described in the legend. Negative perceptions are broadly captured in responses from 1 to 3, and positive perceptions from 4 to 6.

Virtual reality

Perceptions about the legitimacy of VR

Figure 2 shows participant perceptions about the legitimacy of VR for psychological treatment for anxiety.

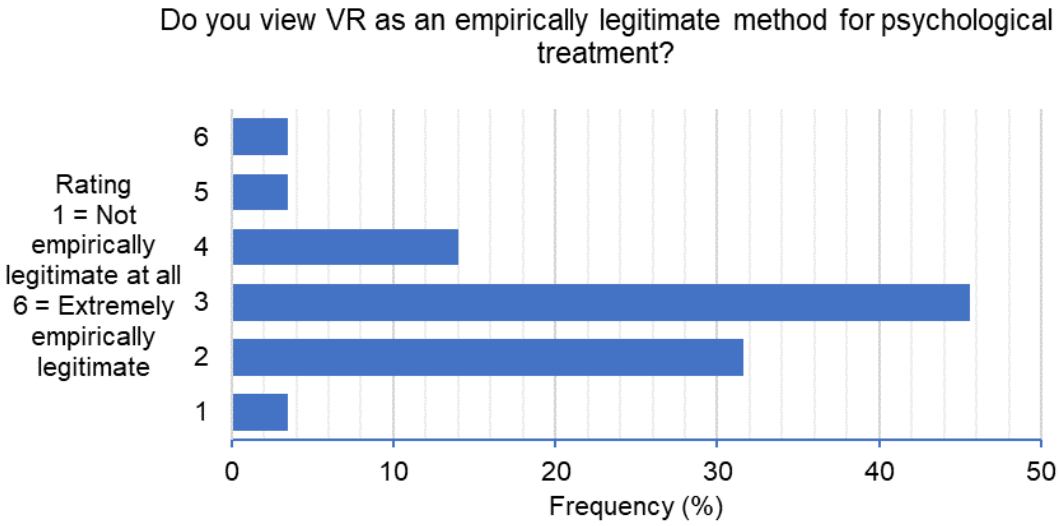

Figure 2: Perceived legitimacy of VR

Perceptions of the effectiveness of VR

Figure 3 demonstrates participant's perceptions on the effectiveness of VR alone, and in comparison to medication and to psychotherapy.

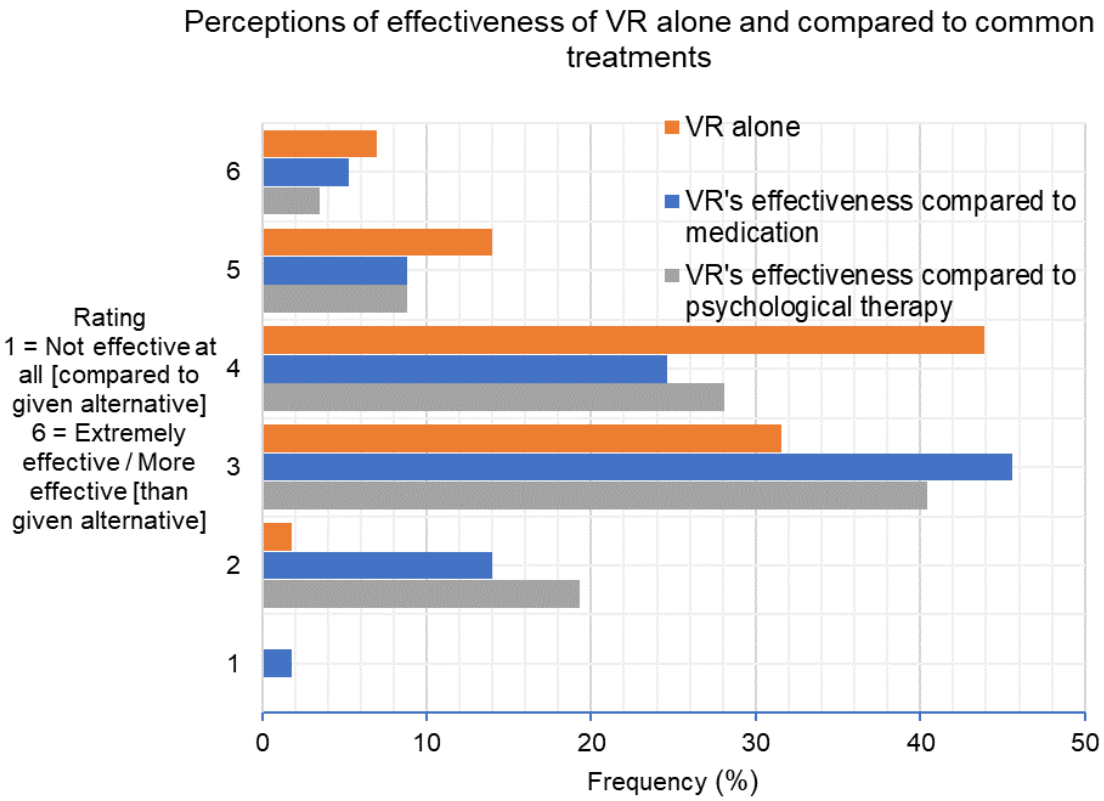

Figure 3: Perceived effectiveness of VR

Willingness to use VR

Participants rated that they would be extremely willing to use VR if it was suggested by their therapist, with 91.3 per cent of responses ranging from 4, 'Moderately willing to use' to 6, 'Extremely willing to use' (Figure 4a).

Figure 4b illustrates participants' ratings of their willingness to use VR as a sole method of treatment for anxiety symptoms, in combination with medication and/or psychotherapy.

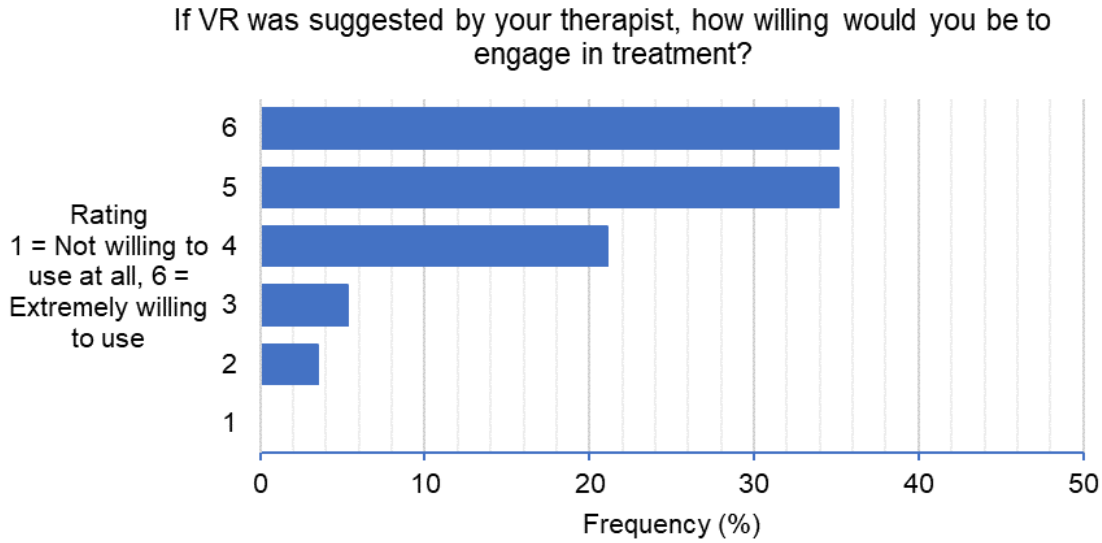

Figure 4a: Willingness to use VR if suggested by therapist

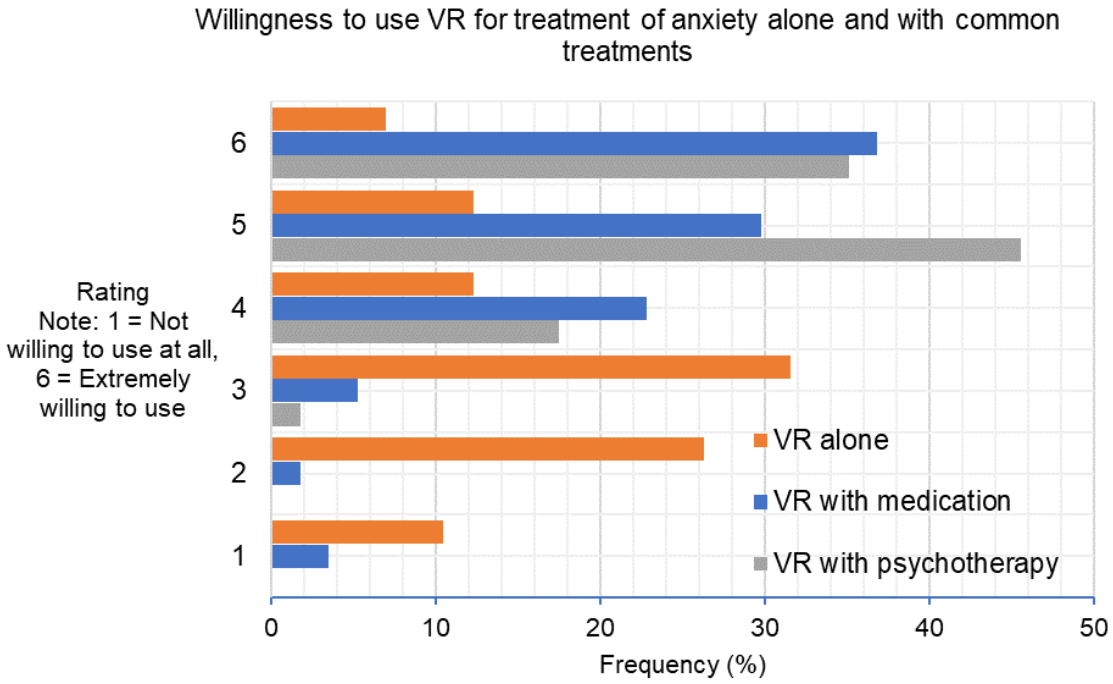

Figure 4b: Willingness to use VR

Mobile apps

Perceptions about the legitimacy of mobile apps

Most participants viewed mobile apps as being a moderately legitimate method for psychological treatment, with 68.5 per cent of responses in the positive range (Figure 5).

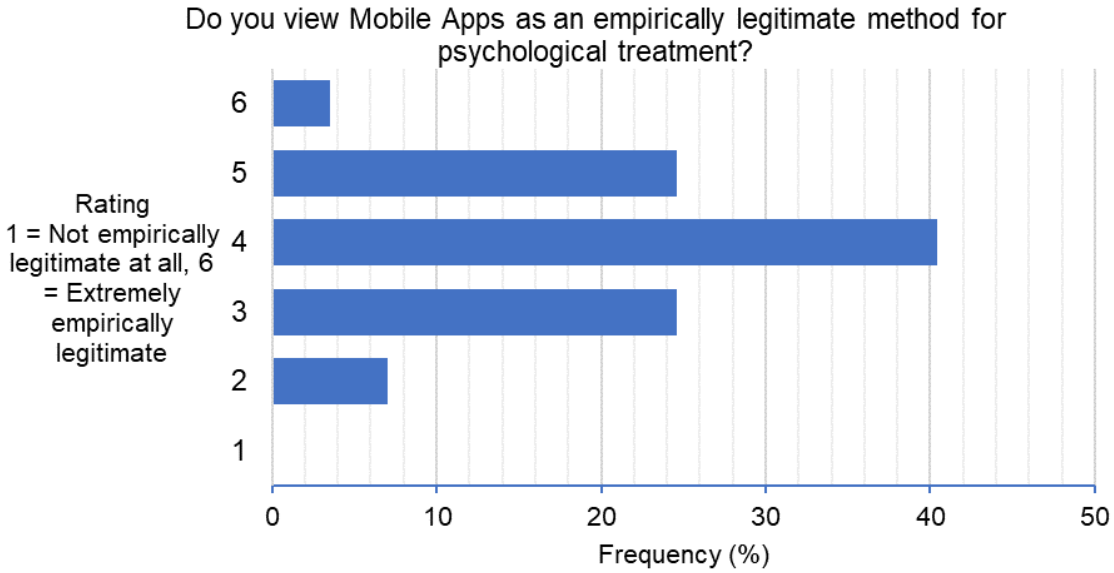

Figure 5: Perceived legitimacy of mobile apps

Perceptions about the effectiveness of mobile apps

Figure 6 shows participant ratings on each question pertaining to the effectiveness of mobile apps. A 60.9 per cent majority of participants positively rated the effectiveness of mobile apps. Comparatively, most participants rated mobile apps as less effective than medication (64.9 per cent) and psychotherapy (70.2 per cent).

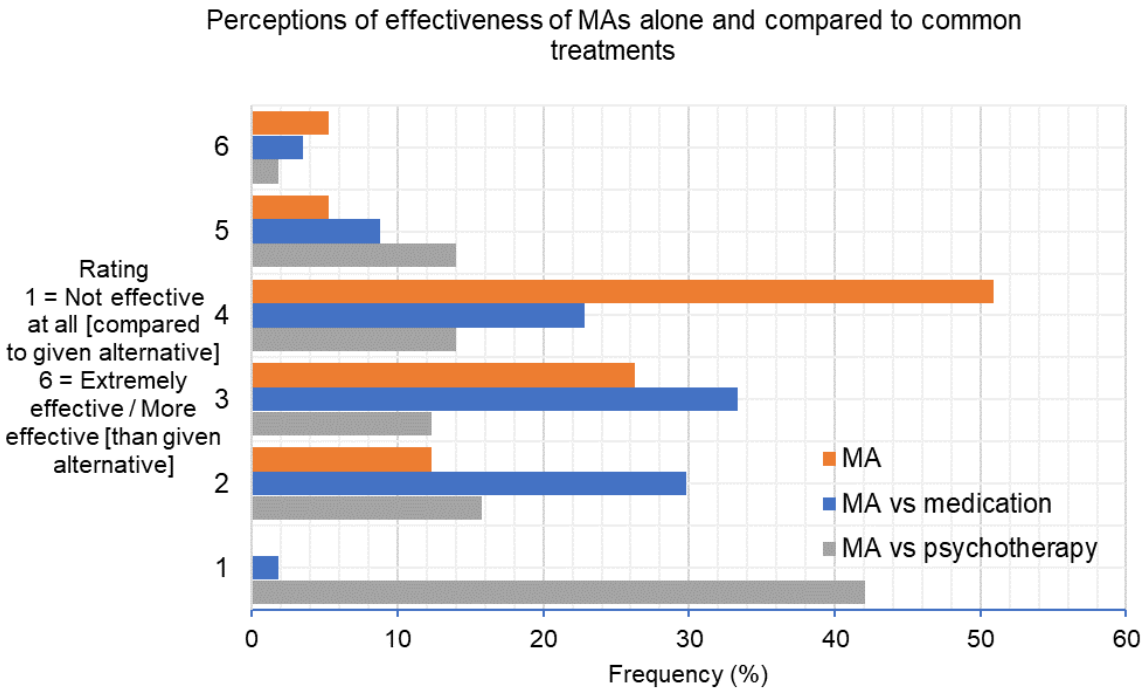

Figure 6: Perceived effectiveness of mobile apps

Willingness to use mobile apps

A majority of participants (84.2 per cent) positively responded that they would be willing to use mobile apps if suggested by their therapist (Figure 7a). A slight majority of participants responded that they would be willing to use mobile apps as their first point of contact over a medical practitioner or psychological therapist for help (Figure 7b). Figure 7c illustrates participants' ratings on willingness to use mobile apps alone and in conjunction with medication and psychological therapy. A slight majority (56.1 per cent) responded in the negative range that they would not be willing to use mobile apps as a sole method of anxiety treatment. Comparatively, 82.5 per cent and 87.8 per cent of responses were positive for using mobile apps in conjunction with medication and psychotherapy, respectively.

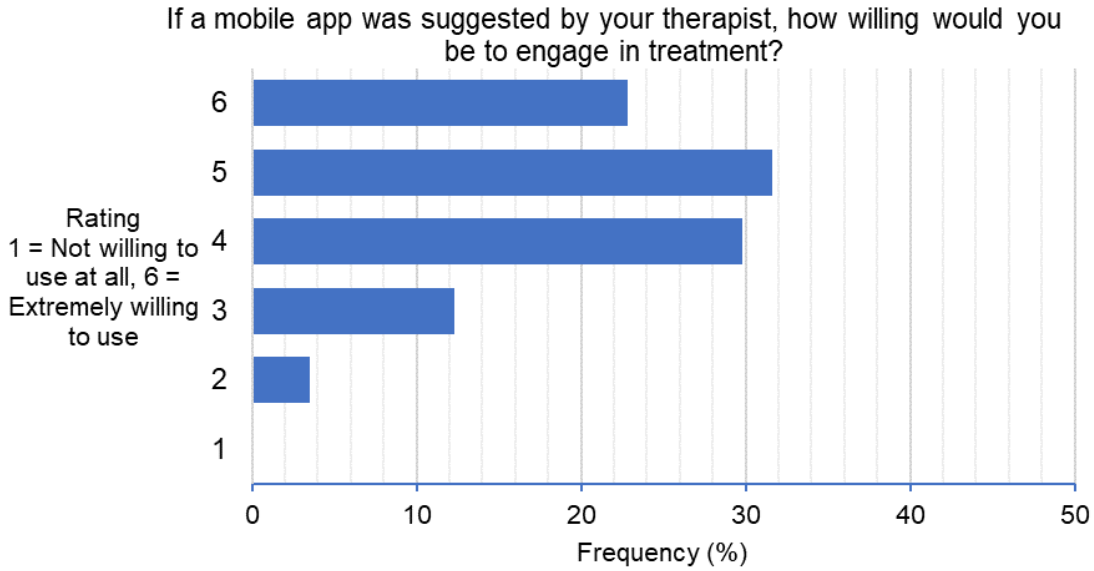

Figure 7a: Willingness to use mobile apps if suggested by therapist

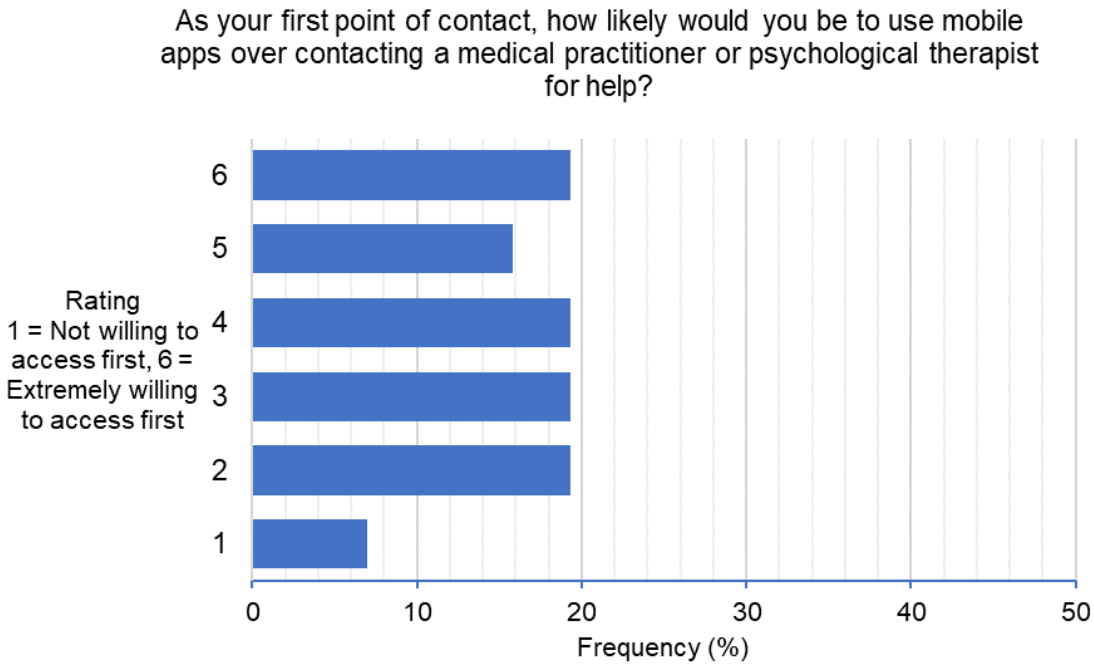

Figure 7b: Willingness to use mobile apps as first point of help-seeking contact

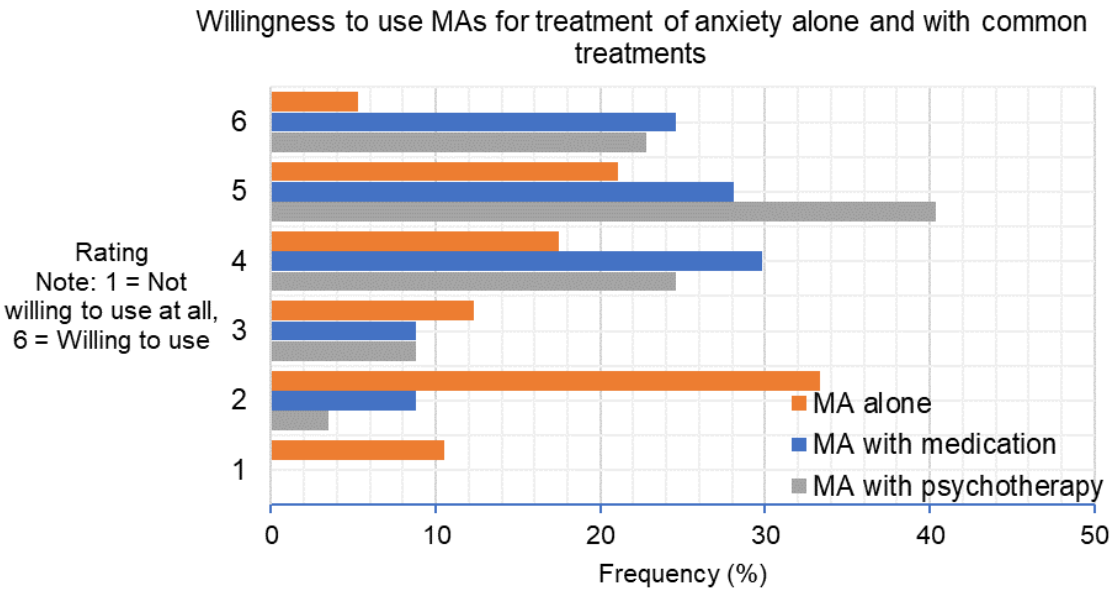

Figure 7c: Willingness to use mobile apps

Barriers to using VR and or mobile apps

Figure 8 illustrates participants' perceptions on a range of potential barriers to using VR and mobile apps including confidentiality, reliance on technology, dizziness/vertigo, infections due to bacteria from sharing equipment, vision complications and motion sickness.

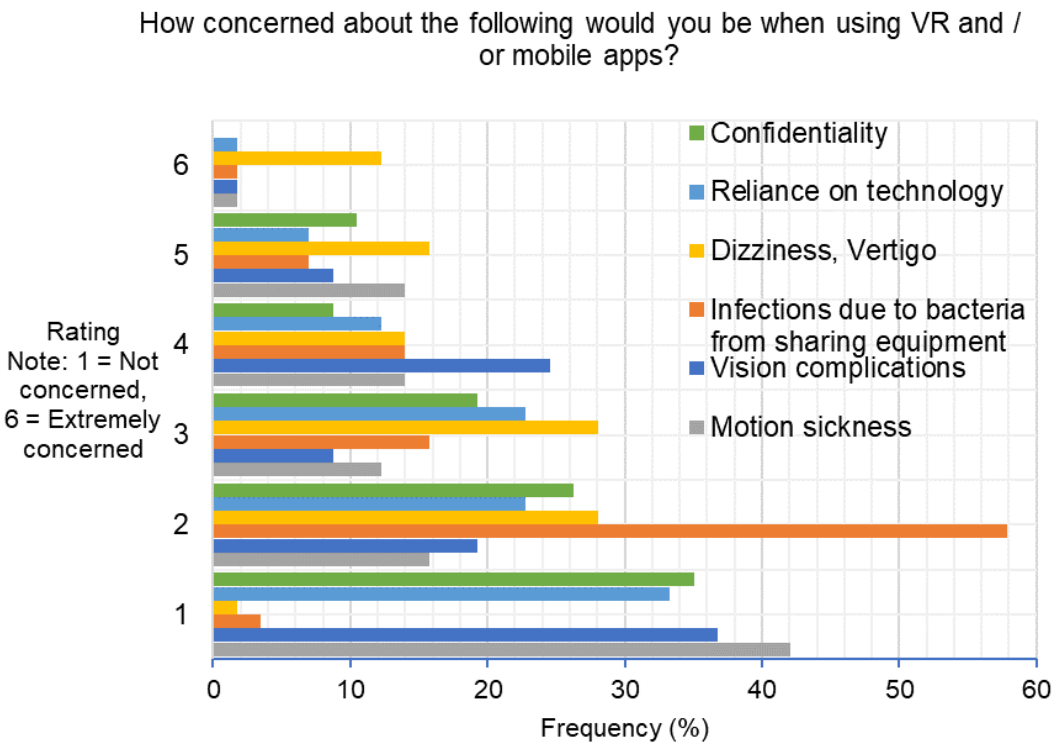

Figure 8: Barriers to using VR and mobile apps

Inferential testing

A maximum likelihood ratio Chi-square test revealed a significant relationship between having experienced anxiety symptoms and perceptions of VRs effectiveness for anxiety (χ^2 (4) = 26.67, p <.00) with a 'large' effect size, Cramer's V (1, N = 55) =.61, p <.00 (Cohen, 1988). On further inspection, this was largely driven by a greater negative rating of VR's effectiveness by the anxiety-experienced group. There were no other significant relationships between having experienced anxiety symptoms and perceived effectiveness of mobile apps (χ^2 (8) = 8.80, p =.40), legitimacy of VR (χ^2 (4) = 8.21, p =.10), or mobile apps (χ^2 (8) = 8.33, p =.46), or likelihood of using a mobile app as first point of contact in seeking help for anxiety (χ^2 (5) = 6.05, p =.37).

Additionally, there were no significant relationships between knowledge that VR is used in mental healthcare and perceptions of its effectiveness (χ^2 (8) = 6.74, p =.64) or legitimacy (χ^2 (8) = 7.99, p =.50). Nor any significant relationship between knowledge that

mobile apps are used in the healthcare sector and perceptions of their effectiveness (χ^2 (8) = 8.80, p =.40) or legitimacy (χ^2 (8) = 8.83, p =.46).

Discussion

This study on VR and mobile app technology used a convenience sample of 18- to 35-year-olds without current or previous mental illness to survey their knowledge, awareness and perceptions of using such technologies for anxiety treatment. The online survey generated several key findings.

Current knowledge

Regarding current knowledge (Figures 1a–1c), half of the sample did not know that VR was currently being used in mental health treatment. This is unsurprising given the non-clinical sample and scarce implementation of VR across mental health locations. Contrastingly, however, three-quarters were aware that mobile apps were used in the healthcare sector. Broadly, the healthcare sector includes general practitioner services, which are frequented more than mental healthcare service (ABS, 2015), and mobile apps are more prevalent across these locations and serve a variety of functions (Overdijkink *et al.*, 2018; Postolache *et al.*, 2014; Postolache *et al.,* 2015). This contrasts significantly with VR, which is not used widely with the public. In a similar vein, nearly three-quarters of participants indicated that they did not know enough about VR to assess whether it was a legitimate treatment method. This is likely due to the lack of contact and knowledge surrounding VR and highlights the need for education surrounding the service when it is introduced to a new client, perhaps more so than the use of a mobile app. Despite this lack of exposure, all bar two participants responded that they were interested in technology in mental health treatment. This overwhelming interest in this space indicates that education and the use of VR and mobile apps in therapy is likely to be well received. This result is also encouraging for treatment adherence to a VR or mobile app therapy.

Perceptions of effectiveness, legitimacy and willingness to use VR

In line with past research, this study found positive public perceptions towards VR (Keller *et al.*, 2017). However, overall, participants viewed VR as moderately illegitimate (Figure 2a) and moderately effective (Figure 3), demonstrating a sense of uncertainty. This uncertainty, however, was overcome by the recommendation to engage with VR if suggested by a therapist (Figure 4a), whereby an overwhelming majority (91.3 per cent) showed a willingness to engage. This highlights the importance of treatment expectations, which may significantly alter not only the willingness to engage in therapy, but the outcomes of therapy and the therapeutic relationship (Wampold, 2015). Of interest, those who stated that they had experienced anxiety symptoms perceived that VR was less effective compared to those who said they had not experienced anxiety symptoms. This result appears to be driven by the anxiety-experienced group perceiving VR as less effective than their non-experienced counterparts.

The differing response pattern between anxiety-experienced and non-experienced respondents on the effectiveness of VR is similar to the response pattern for perceived legitimacy of VR, although this difference was not statistically significantly different. Nonetheless, the pattern whereby anxiety-experienced individuals rate the legitimacy and effectiveness of VR as less than their non-experienced counterparts could be interpreted as an increased uncertainty that VR could be a valid and effective treatment tool. The lack of personal reference for the non-experienced group may mean that they are less able to conceive the problems VR would need to address as a therapy, and thus rate VR more optimistically than their experienced counterparts. To bolster the effectiveness of VR in therapy, clients should be provided information surrounding the effectiveness and legitimacy of this technology prior to, or early in, the therapy process, since client expectations affect therapy outcomes (Field *et al.,* 2017; Greenberg *et al.,* 2006).

Overall, participants indicated that they would be more willing to use VR if their therapist suggested it, or in conjunction with another treatment for anxiety such as medication, rather than using VR as a standalone treatment, which further indicates the participants' uncertainty around the platform (Figure 4b). Concurrently, this demonstrates a consistency between public perceptions and the current state of the literature, where it is suggested that more rigorous research must be conducted before VR can be a standalone therapy (Zeng *et al.*, 2018).

Perceptions of effectiveness, legitimacy and willingness to use mobile apps

Mobile apps, however, were viewed as being moderately effective (Figure 6) and moderately legitimate (Figure 5a). This is in line with previous responses, indicating that the present sample have more exposure to, and knowledge about, mobile apps used in healthcare sectors. This greater exposure to mobile apps over VR may have contributed to higher ratings of perceived legitimacy. Furthermore, participants were highly likely to engage with a mobile app if recommended by their therapist (Figure 7a), but were generally less willing to use it as a sole treatment method, preferring the mobile app to be used in conjunction with another therapy (Figure 7c). This reflects what is currently seen in healthcare, where apps are commonly used as an additive tool to standard treatment (Overdijkink *et al.*, 2018; Postolache *et al.*, 2015).

Perceptions of effectiveness of VR and mobile apps compared to standard treatment

Participants were asked to compare the effectiveness of VR and mobile apps separately to psychotherapy such as CBT and medication. As illustrated in Figure 3, most participants perceived that VR was somewhat ineffective compared to both psychotherapy and medications. In comparison to standard treatment, participants perceived mobile apps alone to be not as effective as medications for anxiety treatment and not effective at all compared to psychotherapy (Figure 6). Although some studies focusing on the effectiveness of VR compared to standard treatment for anxiety demonstrate promising outcomes, few mobile apps that are released publicly are tested as rigorously with a sufficient evidence base in the same manner (Sucala *et al.*, 2017; Lui *et al.*, 2017.) Despite showing effectiveness when empirically supported, this plethora of unsubstantiated mobile apps available (Wang *et al.,* 2018) likely creates an overall perception of ineffectiveness from respondents towards mobile apps.

Mobile apps as first point of contact

The survey additionally asked participants whether they would be likely to use a mobile app as a first point of contact over a medical practitioner or psychological therapist. Figure 7b shows these responses ranging significantly across the scale with almost equal proportions responding from 2 to 6. This is interpreted as an overall positive response, considering that common barriers such as cost and stigma can be reduced by using a

mobile app (Coates *et al.*, 2019). Here, our respondents demonstrate a likelihood to use an available mobile app as their first point of contact in getting help. The availability of such a tool could ultimately increase help-seeking behaviour and reduce the prevalence of untreated anxiety problems. Although not specifically explored in this study, this could be particularly instrumental in encouraging and enabling people from minority and marginalised groups who suffer higher rates of anxiety disorders (Nasir *et al.,* 2018; Said *et al.,* 2013) to take the first step in accessing healthcare.

Interaction of knowledge and perception

Interestingly, participants' knowledge of VR and mobile apps being used in the mental health and healthcare sectors respectively was not related to their perceptions of their effectiveness or legitimacy, suggesting that awareness does not equate to opinion in this space. This highlights the importance of education on the effectiveness and legitimacy of VR and mobile apps regardless of whether people are aware of or have been in contact with these modalities previously.

Barriers to using VR and mobile apps

Finally, the survey assessed perceptions on barriers to using VR and mobile apps (Figure 8). Dizziness and vertigo were perceived as the greatest concern; however, this was only for a minority of the sample. Many studies find that there is no increase in these symptoms (generalised as cybersickness) when assessed before and after using immersive VR (Bouchard *et al.,* 2017; Weech *et al.,* 2019). However, this finding remains key for the implementation of VR given that anxiety levels prior to VR immersion may inflate the side-effects from the experience (Bouchard *et al.,* 2009). Given that a small proportion of individuals have concerns about elements of dizziness and vertigo, introducing VR with information and gradual experience may be useful to mitigate some users' concern.

Limitations

The current findings should be interpreted within the context of several limitations. Firstly, 57 individuals responded to the survey, predominantly through social media and through on-campus advertisements at Monash University. This sample is small and does not represent the Australian population at large. Thus, our results should be interpreted

with caution in applying to a predominantly young-adult, university population. Similarly, we recruited participants without current or previous mental illness. Although many participants have experienced anxiety symptoms, the views of these individuals may be different to those with clinical levels of anxiety. Nonetheless, the views of those with sub-clinical thresholds of anxiety in the 18- to 35-year-old age group remain critically important to understand, given that they are still at greatest risk of experiencing an anxiety condition during these years. If such individuals have limited knowledge or negative perceptions towards treatment, they are less likely to obtain help in the early stages of the illness where intervention is critical and most effective. Given that this study's aim was to assess the public's perceptions of using VR and mobile apps in anxiety treatment, participants were not provided with extensive information on how VR and mobile apps may be incorporated into treatment, nor the capacity in which they are used.

Additionally, the survey did not explain what psychotherapy or CBT entailed or the types of medications used in anxiety treatment. This is concurrently a strength and weakness of the study. While we captured participants' raw perceptions with their current knowledge, participants could not provide an informed opinion on the modalities. In this vein, many of the questions in the survey may have been ambiguous and elicited guesses from the participants, and thus the scores may fluctuate between positive and negative depending on their level of knowledge.

Finally, this study was conducted online and thus inadvertently targeted a technology-using portion of the population. Given the positive uptake of VR by those who are typically not considered 'technology savvy' (Riva, 2016 *et al.,* Syed-Abdul *et al.*, 2019), it is not thought that the perceptions found here would be significantly different to those if a paper-and-pencil survey was used.

Conclusion

This survey was disseminated to the young-adult university population who are at greater risk of developing an anxiety disorder and are thus more likely to consider engaging with VR and mobile app technologies for treatment. At large, a majority of responses indicate that individuals are optimistic about the role of technology in mental health and their use in treatment for anxiety, even without much supporting knowledge

surrounding them. This suggests that VR and mobile apps are likely to be well received as they are validated with a sound evidence base and rolled out in various aspects of mental health. However, this survey highlights a potential higher level of uncertainty around the mediums for anxiety-experienced individuals. This result underscores the need to educate potential clientele on the technology's scientific rigour, effectiveness and legitimacy to achieve best outcomes from therapy. As VR and mobile apps become increasingly well-known, future research should continue to assess the potentially shifting public perceptions, particularly within this age-range, and while accounting for experience with anxiety symptoms.

Acknowledgements

The authors would like to acknowledge the original academic staff who made the Global Leaders and Research Project (GLARP) possible to those from the Centre for Undergraduate Research Initiative for Excellence (CURIE) who contributed to our undergraduate research experience. A special thank you to Associate Professor Ernest Koh, Kate Aldred, Kirra Minton and Hannah Kirk for their help along the way. We would also like to acknowledge our additional original group member Lily Kennard for her contribution to GLARP. Finally, thank you to Dr Lucy Albertella for her support during the writing process.

List of illustrations

Figure 5: Perceived legitimacy of mobile apps

Figure 6: Perceived effectiveness of mobile apps

Figure 7a: Willingness to use mobile apps if suggested by therapist

Figure 7b: Willingness to use mobile apps as first point of help help-seeking contact

Figure 7c: Willingness to use mobile apps

Figure 8: Barriers to using VR and mobile apps

Appendix A

Table 1: Perceptions on the effectiveness and legitimacy of virtual reality

How effective do you view VR as a treatment for anxiety?						
Value	1	2	3	4	5	6
Per cent %	0.0	1.8	31.6	43.9	14.0	7.0
Note: 1 = Not effective at all, 6 = Extremely effective						
Do you view VR as an empirically legitimate method for psychological treatment?						
Value	1	2	3	4	5	6
Per cent %	3.5	31.6	45.6	14.0	3.5	3.5
Note: 1 = Not empirically legitimate at all, 6 = Extremely empirically legitimate						
If VR were suggested by your therapist, how willing would you be to engage in treatment?						
Value	1	2	3	4	5	6
Per cent %	0.0	3.5	5.3	21.1	35.1	35.1
Note: 1 = Not willing to use at all, 6 = Extremely willing to use						

How willing would you be to use VR as a sole method of treatment for anxiety symptoms?						
Value	1	2	3	4	5	6
Per cent %	10.5	26.3	31.6	12.3	12.3	7.0
Note: 1 = Not willing to use at all, 6 = Willing to use alone						

How willing would you be to use VR as a method in conjunction with medication for treatment of anxiety symptoms?						
Value	1	2	3	4	5	6
Per cent %	3.5	1.8	5.3	22.8	29.8	36.8
Note: 1 = Not willing to use at all, 6 = Willing to use						

Would you use VR as a method in conjunction with psychological therapy for treatment of anxiety symptoms?						
Value	1	2	3	4	5	6
Per cent %	0.0	0.0	1.8	17.5	45.6	35.1
Note: 1 = Not willing to use at all, 6 = Willing to use						

How effective do you believe VR treatment alone is compared to medication for anxiety treatment?						
Value	1	2	3	4	5	6
Per cent %	1.8	14.0	45.6	24.6	8.8	5.3
Note: 1 = Not effective at all, 6 = More effective than medication						

How effective do you believe VR is alone compared to psychological therapy such as Cognitive Behaviour Therapy (CBT)?						
Value	1	2	3	4	5	6

Per cent %	0.0	19.3	40.4	28.1	8.8	3.5

Note: 1 = Not effective at all, 6 = More effective than CBT

Table 2: Perceptions on the effectiveness and legitimacy of mobile apps

How effective do you view mobile apps as a treatment for anxiety?						
Value	1	2	3	4	5	6
Per cent %	0.0	12.3	26.3	50.9	5.3	5.3
Note: 1 = Not effective at all, 6 = Extremely effective						

Do you view specifically designed mobile apps as an empirically legitimate method for psychological treatment?						
Value	1	2	3	4	5	6
Per cent %	0.0	7.0	24.6	40.4	24.6	3.5
Note: 1 = Not legitimate at all, 6 = Extremely legitimate						

If a mobile app were suggested by your therapist, how willing would you be to engage in treatment?						
Value	1	2	3	4	5	6
Per cent %	0.0	3.5	12.3	29.8	31.6	22.8
Note: 1 = Not willing to use at all, 6 = Extremely willing to use						

How willing would you be to use mobile apps as a sole method of treatment for anxiety symptoms?						
Value	1	2	3	4	5	6
Per cent %	10.5	33.3	12.3	17.5	21.1	5.3
Note: 1 = Not willing to use at all, 6 = Willing to use alone						

As your first point of contact, how likely would you be to use mobile apps over contacting a medical practitioner or psychological therapist for help?

Value	1	2	3	4	5	6
Per cent %	7.0	19.3	19.3	19.3	15.8	19.3

Note: 1 = Not willing to access first, 6 = Extremely willing to access first

How willing would you be to use mobile apps as a method in conjunction with medication for treatment of anxiety symptoms?

Value	1	2	3	4	5	6
Per cent %	0.0	8.8	8.8	29.8	28.1	24.6

Note: 1 = Not willing to use at all, 6 = Willing to use

Would you use mobile apps as a method in conjunction with psychological therapy for treatment of anxiety symptoms?

Value	1	2	3	4	5	6
Per cent %	0.0	3.5	8.8	24.6	40.4	22.8

Note: 1 = Not willing to use at all, 6 = Willing to use

How effective do you believe mobile apps are alone compared to medication for anxiety treatment?

Value	1	2	3	4	5	6
Per cent %	1.8	29.8	33.3	22.8	8.8	3.5

Note: 1 = Not effective at all, 6 = More effective than medication

How effective do you believe mobile apps are alone compared to psychological therapy such as Cognitive Behaviour Therapy (CBT)?

Value	1	2	3	4	5	6

Per cent %	42.1	15.8	12.3	14.0	14.0	1.8

Note: 1 = Not effective at all, 6 = More effective than CBT

Table 3: Barriers to use

How concerned about the following would you be when using VR and / or mobile apps?						
Motion sickness						
Value	1	2	3	4	5	6
Per cent %	42.1	15.8	12.3	14.0	14.0	1.8
Vision complications						
Value	1	2	3	4	5	6
Per cent %	36.8	19.3	8.8	24.6	8.8	1.8
Infections due to bacteria from sharing equipment						
Value	1	2	3	4	5	6
Per cent %	3.5	57.9	15.8	14.0	7.0	1.8
Dizziness, vertigo						
Value	1	2	3	4	5	6
Per cent %	1.8	28.1	28.1	14.0	15.8	12.3
Reliance on technology						
Value	1	2	3	4	5	6
Per cent %	33.3	22.8	22.8	12.3	7.0	1.8

Confidentiality						
Value	1	2	3	4	5	6
Per cent %	35.1	26.3	19.3	8.8	10.5	0.0

Note: 1 = Not concerned at all, 6 = Extremely concerned

Table 4: Advantages to use

How advantageous or better do you view VR for the following factors compared to current mainstream treatments (medications, psychological therapy)?						
Accessibility for less-mobile individuals						
Value	1	2	3	4	5	6
Per cent %	12.3	5.3	24.6	19.3	19.3	19.3
Accessibility for those with financial hardship						
Value	1	2	3	4	5	6
Per cent %	22.8	7.0	24.6	14.0	14.0	17.5
Time commitment						
Value	1	2	3	4	5	6
Per cent %	12.3	14.0	26.3	14.0	17.5	15.8

Note: 1 = No better than current treatments, 6 = Much better than current treatments.

Appendix B

MONASH University

Monash University Human Research Ethics Committee

Approval Certificate

This is to certify that the project below was considered by the Monash University Human Research Ethics Committee. The Committee was satisfied that the proposal meets the requirements of the *National Statement on Ethical Conduct in Human Research* and has granted approval.

Project ID: 18379
Project Title: Public perceptions on using VR and Mobile Apps in Mental Health treatment
Chief Investigator: Assoc Professor Ernest Koh
Approval Date: 07/02/2019
Expiry Date: 07/02/2024

Terms of approval - failure to comply with the terms below is in breach of your approval and the *Australian Code for the Responsible Conduct of Research*.

1. The Chief Investigator is responsible for ensuring that permission letters are obtained, if relevant, before any data collection can occur at the specified organisation.
2. Approval is only valid whilst you hold a position at Monash University.
3. It is responsibility of the Chief Investigator to ensure that all investigators are aware of the terms of approval and to ensure the project is conducted as approved by MUHREC.
4. You should notify MUHREC immediately of any serious or unexpected adverse effects on participants or unforeseen events affecting the ethical acceptability of the project.
5. The Explanatory Statement must be on Monash letterhead and the Monash University complaints clause must include your project number.
6. Amendments to approved projects including changes to personnel must not commence without written approval from MUHREC.
7. Annual Report - continued approval of this project is dependent on the submission of an Annual Report.
8. Final Report - should be provided at the conclusion of the project. MUHREC should be notified if the project is discontinued before the expected completion date.
9. Monitoring - project may be subject to an audit or any other form of monitoring by MUHREC at any time.
10. Retention and storage of data - The Chief Investigator is responsible for the storage and retention of the original data pertaining to the project for a minimum period of five years.

Kind Regards,

Professor Nip Thomson

Chair, MUHREC

CC: Ms Rebecca Kirkham, Ms Caitlin Batten, Lily Kennard

List of approved documents:

Document Type	File Name	Date	Version
Supporting Documentation	RF007_2018 (VR and Mental Health) - Advertising materials	16/01/2019	1.0
Consent Form	RF007 _2018 - Consent Form	16/01/2019	1.0
Questionnaires / Surveys	RF007_2018 (VR and Mental Health) - Survey	16/01/2019	1.0
Supporting Documentation	RF007_2018 (VR and Mental Health) - Funding Application	16/01/2019	1.0
Supporting Documentation	RF007_2018 (VR and Mental Health) - Funding Letter - Batten, Kennard, Kirkham (Signed)	16/01/2019	1.0
Explanatory Statement	RF007_2018 (VR and Mental Health) - Explanatory Statement - amended	29/01/2019	2.0

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References

Alyami, M., B. Giri, H. Alyami and F. Sundram (2017). 'Social anxiety apps: A systematic review and assessment of app descriptors across mobile store platforms', *Evidence-Based Mental Health*, 20 (3), 65–70

Anderson, P., B. O. Rothbaum and L. F. Hodges (2003), 'Virtual reality exposure in the treatment of social anxiety', *Cognitive and Behavioral Practice*, 10 (3), 240–47

Arch, J. J., and M. G. Craske (2009), 'First-line treatment: A critical appraisal of cognitive behavioral therapy developments and alternatives', *Psychiatric Clinics of North America*, 32 (3), 525–47

Australian Bureau of Statistics (ABS) (2015), '4329. 0. 00. 004 National Health Survey: Mental Health and co-existing physical health conditions, Australia', available at http://www.abs.gov.au/ausstats/abs@.nsf/0/C0A4290EF1E7E7FDCA257F1E001C0B84?Opendocument, accessed 11 July 2018

Australian Bureau of Statistics (ABS) (2018), 'National Health Survey: First Results 2017–18' available at https://www. abs. gov. au/ausstats/abs@. nsf/Lookup/by%20Subject/4364. 0. 55. 001~2017–18~Main%20Features~Mental%20and%20behavioural%20conditions~70, accessed 10 March 2020

Bouchard, S., J. St-Jacques, P. Renaud and B. K. Wiederhold (2009), 'Side effects of immersions in virtual reality for people suffering from anxiety disorders', *Journal of CyberTherapy & Rehabilitation*, 2 (2), 127

Bouchard, S., G. Robillard, I. Giroux, C. Jacques, C. Loranger, M. St-Pierre, M. Chrétien, and A. Goulet (2017). 'Using virtual reality in the treatment of gambling disorder: The development of a new tool for cognitive behavior therapy', *Frontiers in Psychiatry*, 8, 27

Botella, C., J. Fernández-Álvarez, V. Guillén, A. García-Palacios and R. Baños (2017). 'Recent progress in virtual reality exposure therapy for phobias: A systematic review', *Current Psychiatry Reports*, 19 (7), 42

Bystritsky, A. (2006), 'Treatment–resistant anxiety disorders', *Molecular Psychiatry*, 11 (9), 805–14

Carl, E., A. T. Stein, A. Levihn-Coon, J. R. Pogue, B. Rothbaum, P. Emmelkamp and M. B. Powers (2019), 'Virtual reality exposure therapy for anxiety and related disorders: A meta-analysis of randomized controlled trials', *Journal of Anxiety Disorders*, 61, 27–36

Coates, D., C. Saleeba and D. Howe (2019), 'Mental health attitudes and beliefs in a community sample on the central coast in Australia: Barriers to help seeking', *Community Mental Health Journal*, 55 (3), 476–86

Coles, M. E., and S. L. Coleman (2010), 'Barriers to treatment seeking for anxiety disorders: Initial data on the role of mental health literacy', *Depression and Anxiety*, 27 (1), 63–71

Cote, S., and S. Bouchard (2008), 'Virtual reality exposure for phobias: A critical review', *Journal of CyberTherapy and Rehabilitation*, 1 (1), 75–92

Curcio, C., and D. Corboy (2020), 'Stigma and anxiety disorders: A systematic review', *Stigma and Health*, 5 (2), 125

David, D., I. Cristea and S. G. Hofmann (2018), 'Why cognitive behavioral therapy is the current gold standard of psychotherapy', *Frontiers in Psychiatry*, 9, 4

Donker, T., I. Cornelisz, C. Van Klaveren, A. Van Straten, P. Carlbring, P. Cuijpers, and J. L. Van Gelder (2019), 'Effectiveness of self-guided app-based virtual reality cognitive behavior therapy for acrophobia: A randomized clinical trial', *JAMA Psychiatry*, 76 (7), 682–90

Donker, T., K. Petrie, J. Proudfoot, J. Clarke, M. R. Birch and H. Christensen (2013), 'Smartphones for smarter delivery of mental health programs: A systematic review', *Journal of Medical Internet Research*, 15 (11), e247

Farach, F. J., L. D. Pruitt, J. J. Jun, A. B. Jerud, L. A. Zoellner and P. P. Roy-Byrne (2012), 'Pharmacological treatment of anxiety disorders: Current treatments and future directions', *Journal of Anxiety Disorders*, 26 (8), 833–43

Field, T. A., E. T. Beeson, L. K. Jones and R. Miller (2017), 'Counselor allegiance and client expectancy in neuroscience-informed cognitive-behavior therapy: A 12–month qualitative follow-up', *Journal of Mental Health Counseling*, 39 (4), 351–65

Firth, J., J. Torous, J. Nicholas, R. Carney, S. Rosenbaum, and J. Sarris, (2017), 'Can smartphone mental health interventions reduce symptoms of anxiety? A meta-analysis of randomized controlled trials', *Journal of Affective Disorders*, 218, 15–22

Garcia-Palacios, A., C. Botella, H. Hoffman and S. Fabregat (2007), 'Comparing acceptance and refusal rates of virtual reality exposure vs. in vivo exposure by patients with specific phobias' *Cyberpsychology & Behavior*, 10 (5), 722–24

Greenberg, R. P., M. J. Constantino and N. Bruce, N (2006), 'Are patient expectations still relevant for psychotherapy process and outcome?', *Clinical Psychology Review*, 26 (6), 657–78

Harris, M. G., M. J. Hobbs, P. M. Burgess, J. E. Pirkis, S. Diminic, D. J. Siskind, G. Andrews, and H. A. Whiteford (2015), 'Frequency and quality of mental health treatment for affective and anxiety disorders among Australian adults', *Medical Journal of Australia*, 202 (4), 185–89

Hofmann, S. G., A. Asnaani, I. J. J. Vonk, A. T. Sawyer and A. Fang (2012), 'The efficacy of cognitive behavioral therapy: A review of meta-analyses', *Cognitive Therapy and Research*, 36 (5), 427–40

Jorm, A. F. (2000), 'Mental health literacy: Public knowledge and beliefs about mental disorders', *Br J Psychiatry*, 177, 396–401

Kampmann, I. L., P. M. Emmelkamp, D. Hartanto, W. P. Brinkman, B. J. Zijlstra and N. Morina (2016), 'Exposure to virtual social interactions in the treatment of social anxiety disorder: A randomized controlled trial', *Behaviour Research and Therapy*, 77, 147–56

Keller, M. S., H. J. Park, M. E. Cunningham, J. E. Fouladian, M. Chen and B. M. R. Spiegel (2017), 'Public perceptions regarding use of Virtual Reality in health care: A social media content analysis using Facebook', *Journal of Medical Internet Research*, 19 (12), e419

Loerinc, A. G., A. E. Meuret, M. P. Twohig, D. Rosenfield, E. J. Bluett and M. G. Craske (2015), 'Response rates for CBT for anxiety disorders: Need for standardized criteria', *Clinical Psychology Review*, 42, 72–82

Lijster, J. M. D., B. Dierckx, E. M. Utens, F. C. Verhulst, C. Zieldorff, G. C. Dieleman and J. S. Legerstee (2017), 'The age of onset of anxiety disorders: A meta-analysis', *The Canadian Journal of Psychiatry*, 62 (4), 237–46

Lipschitz, J., C. J. Miller, T. P. Hogan, K. E. Burdick, R. Lippin-Foster, S. R. Simon and J. Burgess (2019), 'Adoption of mobile apps for depression and anxiety: Cross-sectional survey study on patient interest and barriers to engagement', *JMIR Mental Health*, 6 (1), 11334

Lui, J. H., D. K. Marcus and C. T. Barry (2017), 'Evidence-based apps? A review of mental health mobile applications in a psychotherapy context', *Professional Psychology: Research and Practice*, 48 (3), 199

McHugh, M. L. (2013), 'The chi-square test of independence', *Biochemia Medica*, 23 (2), 143–49

Morina, N., H. Ijntema, K. Meyerbröker and P. M. Emmelkamp (2015), 'Can virtual reality exposure therapy gains be generalized to real-life? A meta-analysis of studies applying behavioral assessments', *Behaviour Research and Therapy*, 74, 18–24

Nasir, B. F., M. R. Toombs, S. Kondalsamy-Chennakesavan, S. Kisely, N. S. Gill, E. Black, N. Hayman, G. Ranmuthugala, G. Beccaria, R. Ostini, and G. C. Nicholson (2018), 'Common mental disorders among Indigenous people living in regional, remote and metropolitan Australia: A cross-sectional study', *BMJ Open*, 8 (6), e020196

Osuch, E. A., E. Vingilis, C. Summerhurst, C. I. Forster, E. E. Ross, and A. J. Wrath (2015), 'Process evaluation of an early-intervention program for mood and anxiety disorders among older adolescents and young adults', *Psychiatric Services*, 66 (10), 1113–17

Overdijkink, S. B., A. V. Velu, A. N. Rosman, M. D. Van Beukering, M. Kok and R. P. Steegers-Theunissen (2018), 'The usability and effectiveness of mobile health technology–based lifestyle and medical intervention apps supporting health care during pregnancy: systematic review', *JMIR mHealth and uHealth*, 6 (4), e109

Parsons, T. D., and A. A. Rizzo (2008), 'Affective outcomes of virtual reality exposure therapy for anxiety and specific phobias: A meta-analysis', *Journal of Behavior Therapy and Experimental Psychiatry*, 39 (3), 250–61

Postolache, G., P. S. Girao, and O. Postolache (2014), 'Applying smartphone apps to drive greater patient engagement in personalized physiotherapy', in *IEEE International Symposium on Medical Measurements and Applications (MeMeA)*, June 2014 Lisbon; IEEE, pp. 1–6

Postolache, O., F. Cary, P. S. Girão, and N. Duarte (2015), 'Physiotherapy assessment based on Kinect and mobile APPs', In *2015 6th International Conference on Information, Intelligence, Systems and Applications (IISA)*, July 2015, Corfu; IEEE, pp. 1–6

Reardon, T., K. Harvey, M. Baranowska, D. O'Brien, L. Smith, and C. Creswell (2017), 'What do parents perceive are the barriers and facilitators to accessing psychological treatment for mental health problems in children and adolescents? A systematic review of qualitative and quantitative studies', *European Child & Adolescent Psychiatry*, 26 (6), 623–47

Riva, G., R. M. Baños, C. Botella, F. Mantovani, and A. Gaggioli (2016), 'Transforming experience: the potential of augmented reality and virtual reality for enhancing personal and clinical change', *Front. Psychiatry*, 7, 164

The Royal Australian and New Zealand College of Psychiatrists (RANZCP) (2014), 'The economic cost of serious mental illness and comorbidities in Australia and New Zealand', available at https://www.ranzcp.org/files/resources/reports/ranzcp-serious-mental-illness.aspx, accessed 10 March 2020

The Royal Australian and New Zealand College of Psychiatrists (RANZCP) (2015) 'Minding the Gaps: Cost barriers to accessing health care for people with mental illness', available at https://www.ranzcp.org/files/resources/reports/minding-the-gaps-cost-barriers-to-accessing-health.aspx, accessed 21 October 2020

Topper, M., P. M. Emmelkamp, E. Watkins, and T. Ehring, (2017), 'Prevention of anxiety disorders and depression by targeting excessive worry and rumination in adolescents and young adults: A randomized controlled trial', *Behaviour Research and Therapy*, 90, 123–36

Roy–Byrne, P. (2015), 'Treatment–refractory anxiety; definition, risk factors, and treatment challenges', *Dialogues in Clinical Neuroscience*, 17 (2), 191–206

Said, D., K. Kypri, and J. Bowman (2013). 'Risk factors for mental disorder among university students in Australia: Findings from a web-based cross-sectional survey', *Social Psychiatry and Psychiatric Epidemiology*, 48 (6), 935–44

Stolz, T., A. Schulz, T. Krieger, A. Vincent, A. Urech, C. Moser, S. Westermann, and T. Berger (2018), 'A mobile app for social anxiety disorder: a three-arm randomized controlled trial comparing mobile and PC-based guided self-help interventions', *Journal of Consulting and Clinical Psychology*, 86 (6), 493–504

Sucala, M., P. Cuijpers, F. Muench, R. Cardos, R. Soflau, A. Dobrean, P. Achimas-Cadariu, and D. David (2017), 'Review of anxiety: There is an app for that. A systematic review of anxiety apps', *Depression and Anxiety*, 34 (6), 518–25

Syed-Abdul, S., S. Malwade, A. A. Nursetyo, M. Sood, M. Bhatia, D. Barsasella, M. F. Liu, C.C. Chang, K. Srinivasan, M. Raja, and Y. C. J. Li, (2019). 'Virtual reality among the elderly: A usefulness and acceptance study from Taiwan', *BMC Geriatrics*, 19 (1), 223

Taylor, S., J. S. Abramowitz and D. McKay (2012), 'Non-adherence and non-response in the treatment of anxiety disorders', *Journal of Anxiety Disorders*, 26 (5), 583–89

Valmaggia, L. R., L. Latif, M. J. Kempton and M. Rus-Calafell (2016), 'Virtual reality in the psychological treatment for mental health problems: A systematic review of recent evidence', *Psychiatry Research*, 236, 189–95

Vogel, D. L., N. G. Wade and S. Haake (2006), 'Measuring the self-stigma associated with seeking psychological help', *Journal of Counseling Psychology*, 53, 325–37

Vogel, D. L., N. G. Wade and A. H. Hackler (2007), 'Perceived public stigma and the willingness to seek counselling', *Journal of Counseling Psychology*, 54, 40–50

Wampold, B. E., (2015), 'How important are the common factors in psychotherapy? An update', *World Psychiatry*, 14 (3), 270–77

Wang, K., D. S. Varma and M. Prosperi, (2018), 'A systematic review of the effectiveness of mobile apps for monitoring and management of mental health symptoms or disorders', *Journal of Psychiatric Research*, 107, 73–78

Weech, S., Kenny, S. and M. Barnett-Cowan (2019). 'Presence and cybersickness in virtual reality are negatively related: A review', *Frontiers in Psychology*, 10, 158

Zeng, N., Z. Pope, J. E. Lee, and Z. Gao (2018), 'Virtual reality exercise for anxiety and depression: A preliminary review of current research in an emerging field', *Journal of Clinical Medicine*, 7 (3), 42

Glossary

Psychotherapy: The intentional engagement with a therapist for the purpose of healing, growth, transformation of a range of issues, including emotional and mental health concerns such as anxiety. It can take many forms and include talking, group work, art, movement and more. It aims to support and increase awareness in the client, facilitate development, growth, efficacy and enhance their wellbeing.

Pharmaceuticals: Any kind of drug used for medicinal or therapeutic purposes, such as to reduce the symptoms of anxiety.

Cognitive Behavioural Therapy (CBT): A type of psychotherapy which focuses on challenging and changing unhelpful ways of thinking, feeling and behaving. It aims to improve emotional regulation and help to develop personal coping strategies that target solving current problems.

Pharmacotherapy: The use of a drug for therapeutic purposes, such as to reduce the symptoms of anxiety.

Virtual reality (VR): A computer-generated simulation of a three-dimensional environment that can be interacted with in a seemingly real or physical way by a person. It is usually engaged with via electronic devices, such as special goggles with a screen or gloves fitted with sensors.

Stigma: A negative attitude or a mark of shame, disgrace or disapproval by other individuals, society or the self that results in an individual being or feeling rejected, discriminated against and excluded from participating in different areas of society.

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Knowledge and Habits Towards Antibiotic Use and Resistance of Public University Students in Nisava Region – Southern Serbia

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Abstract

Antibiotic resistance has become a serious threat to **global health**. This study aimed to assess knowledge and habits surrounding the use of **antibiotics** and antibiotic resistance of university students residing in urban areas compared to those in rural areas of Nisava region, Serbia. Data was gathered using an online survey and tested for statistical differences using the Chi-squared test. A total of 380 students participated with a response rate of 94.7 per cent. Of this, 84.4 per cent of students correctly identified antibiotics as being effective against bacteria and distinguished well between antibiotics and other types of medicines. However, 31.4 per cent believe that antibiotics help with most diseases, not just bacteria-related illnesses. While only 12.5 per cent said they believed that therapy can be interrupted when the symptoms fade, a total of 45.8% admitted to premature treatment interruption. As many as 59.7 per cent reported having bought antibiotics without a prescription, and a significant portion of 62.5 per cent reported having taken antibiotics for travel emergencies. There was no statistically significant difference related to the domicile of the students ($p>0.05$). Students demonstrated relatively acceptable knowledge on antibiotics use and antibacterial resistance – which is not reflected in their practice of using antibiotics. Campaigns are needed to promote awareness on antibiotic resistance as students' habits are not satisfactory.

Keywords: Antibiotics usage habits, antibiotic resistance awareness, Serbia, students, public health

Introduction

Paul Ehrlich, Nobel prize laureate in medicine in 1908, famously called antibiotics *magic bullets*: a completely safe medicine directly specific for the target (Valent *et al.,* 2016: 118). Throughout the Second World War, antibiotics were advertised as able to cure any disease, and the *British Medical Journal* stated that 'penicillin is to other antiseptics what radium is to other metals' (Shama, 2015: 132). Such beliefs have led to inappropriate usage of antibiotics in recent decades. Inappropriate use practices include self-medication, missed purpose, short duration of treatment, inadequate dose, or stopping prematurely upon improvement of disease symptoms (Ocan *et al.,* 2015). The percentage of self-medicating patients in Europe has grown in the past years from 5 per cent in 2009 to 7 per cent in 2016 (Lescure *et al.,* 2018), ranging from 3 per cent in Northern Europe (Horvat *et al.,* 2018) to the largest rates in countries of South-Eastern Europe. This includes 28 per cent in Slovenia and 20.5 per cent in Croatia, neighbouring countries to Serbia where this study was conducted (Grigoryan *et al.,* 2010).

Literature data cites that the public unawareness level regarding the ineffectiveness of antibiotics in viral diseases was as high as 57 per cent (Machowska and Lundborg, 2018: 27). Extensive use of antibiotics has been reported in cases of upper respiratory tract infections, despite that these infections are mostly viral in origin (Ochoa *et al.,* 2000). In general, antibiotics cannot be used to treat viral infections as viruses feature no molecular targets attacked by antibiotics (Dworkin, 2003). Non-adherence to dosing regimens is also common, either prolonging the course or ending it prematurely as soon as the symptoms fade. The latter is especially dangerous as it may leave some more resistant pathogens behind that reintroduce the illness.

Antibacterial resistance: a global danger

Antibacterial resistance (ABR) is an ability of bacteria to develop resistance towards the drug employed (Aslam *et al.,* 2018: 1645–46). It occurs when bacteria change in response to usage of antibiotics. While it does occur naturally, the highly increasing rate of ABR is linked to inappropriate usage of antibiotics (World Health Organization, 2020).

The bacterial population, and not the organism in which they reside, develops resistance over generations, with the fittest bacteria surviving. (Brookes-Howell *et al.,* 2012). First

cases were reported soon after the discovery of **penicillin** (Lee Ventola, 2015). Antibiotic resistance leads to higher medical costs, prolonged hospital stays and increased mortality (World Health Organization, 2020). An estimated 25,000 deaths in Europe and 23,000 in USA per year are linked to antibiotic-resistant bacteria (Laxminarayan *et al.,* 2013: 1060).

One typically identifies four mechanisms that bacteria employ to protect themselves from antibiotics (Hawkey, 1998): (i) The resistant bacteria may prevent the antibiotic from reaching the **sensitive target** on the bacterium, or (ii) the sensitive target may be altered, preventing the antibiotic from inhibiting bacterial activity due to structural changes in the molecule. (iii) Bacteria may also produce an alternative target that is resistant to inhibition by the antibiotic, therefore protecting the initial sensitive site. Finally, (iv) the antibiotic may be prevented from entering the cell or pumped out of the cell at a rate faster than the one at which it enters the cell. Lowering the effect of antibiotics means that the disease becomes more dangerous and more difficult to cure, representing great danger to public health (Pechère *et al.,* 2007, Fair and Tor, 2014).

Need for a new study

Inappropriate use of antibiotics, ultimately leading to ABR, is a problem in the broader region of the Balkans and South-Eastern Europe, including very high consumption rates reported in Romania, Greece, Montenegro and Turkey (World Health Organization, 2018: 28). Antibiotic consumption in Serbia was among the highest in Europe in 2015 (World Health Organization, 2018). A nationwide campaign in 2016 managed to reduce it, but still keeping it much higher than the European average (World Bank, 2018). Also, past studies have reported erroneous practices in Serbia. Serbian households often keep antibiotics in home pharmacies (Paut Kusturica *et al.,* 2015: 115) and over-prescription by physicians has occurred even after the completion of the campaign, notably in cases of acute bronchitis (Petrovic *et al.,* 2019: 687). In addition, Serbia is among few European countries not participating in ESAC-Net (European Surveillance of Antimicrobial Consumption Network) (Horvat *et al.,* 2018). This indicates a link between high antibiotic consumption and erroneous attitudes of the public, showing that further investigation of attitudes of the public is needed.

Aforementioned dangers of inappropriate use and the unfavourable situation in Serbia have motivated this study, whose primary goal was to investigate students' knowledge and habits regarding antibiotic usage and ABR in a public university in the Nisava region of Southern Serbia and compare them to available data from the immediate region and from other developing countries. A secondary goal was to inspect differences between answers of students coming from rural areas and those from urban regions, as different socio-economic statuses and different beliefs of communities more inclined to traditional medicine and curing methods have shown to influence the attitudes of patients towards drug use (Akici *et al.,* 2017; Peng *et al.,* 2018).

Based on previous studies, healthcare and socio-economic differences (Primary Healthcare Centre Nis, 2020), we expected that our sample would demonstrate doubts regarding knowledge, as well as erroneous usage and self-medication, with less appropriate attitudes present in the rural region.

It is important to assess the knowledge on the subject among the population of university students, whose opinion will become that of the most educated population of the country. This way, gaps in their knowledge can be identified, and antibiotic stewardship campaigns can be planned to contribute to the action of stopping antibiotic resistance. Such campaigns were successfully conducted in many countries, such as France, where knowledge improved from 2002 to 2007 (Sabuncu *et al.,* 2009).

Past studies in Serbia mostly concentrated on habits of antibiotics usage in hospitals in other regions of the country and were written from a clinician's point of view. There is currently a paucity of data addressing public's attitudes. Therefore, this study on the knowledge and habits towards antibiotic use and resistance of public university students in Southern Serbia provides novel information and contributes to the global knowledge on the subject.

Materials and methods

This study concentrated on students at Nis University, the only university centre in the region. It has 20,455 undergraduate students (Janković, 2017). The sample size of 378 was calculated using *Raosoft* calculator, with a confidence interval of 95 per cent and a margin of error of 5 per cent.

We used a stratified sample, aiming to roughly equalise the number of students coming from urban and rural areas for direct comparison. The students included were undergraduates – excluding students of medicine and pharmacology from the Faculty of Medicine – as well as students of biology and chemistry from the Faculty of Natural Sciences. This was to avoid potential response bias as the above-mentioned courses were linked to the current topic.

This research was exempt from ethical committee evaluation as it only acquired opinions of the surveyed parties. Prior to completing the survey, all participants gave personal informed consent about processing of personal information and data use for the purpose of the research. There was no compensation nor reward offered to the participants.

Questions were designed in compliance with previous successful studies from Saudi Arabia (Zaidi *et al.,* 2020), Italy (Napolitano *et al.,*2013), China (Zhu *et al.,* 2016) and South Sudan (Sa'adatu Sunusi *et al.,* 2019). The questions were altered to include commercial names of the drugs used in Serbia (such as paracetamol). The questionnaire had 16 questions in Serbian language and was available online and in paper format. The questions are given in Table 1.

Subsequently, the results have been quantified and represented in percentile. The data was analysed on the level of whole group, as well as on the two groups of students coming from the surrounding rural area belonging to the Nisava region (Group A) and from the urban territory of city of Nis where university is located (Group B). For statistical difference, the common χ^2-test for independence (Chi-squared test) was used, where value $p<0.05$ was considered significant.

	Question	Answers
KNOWLEDGE		
1.	Antibiotics are effectively used against (more responses possible):	***bacteria***, *viruses*, *fungus*
2.	Mark the drugs that are antibiotics (more responses possible):	*Paracetamol* (acetaminophen)* *Brufen* (ibuprofen)* *Probiotic* ***Sinacillin*** *(****Amoxicillin****)* *Bromazepam* ***Penicillin***
KNOWLEDGE		

Question ers

3.	Antibiotics need not be taken in regular intervals, if the daily dosage is respected.	Yes/**No**
4.	Antibiotics help with all types of cough, throat pain and common cold.	Yes/**No**
5.	Antibiotics can be kept for further usage, if the illness reappears.	Yes/**No**
6.	Antibiotics can help with most diseases.	Yes/**No**
7.	Taking antibiotics preventively can immunise us against the common flu.	Yes/**No**
8.	Therapy may be interrupted when the symptoms fade out.	Yes/**No**
HABITS		
1.	Have you ever acquired antibiotics with no prescription?	Yes/**No**
2.	Have you ever acquired antibiotics preventively?	Yes/**No**
3.	Would you consume alcohol during your therapy with antibiotics?	Yes/**No**
4.	Do you carry an antibiotic when you travel, if someone falls ill?	Yes/**No**
5.	Have you ever interrupted your regime before the time prescribed?	Yes/**No**
6.	Do you always inspect the instruction manual and check the expiry date prior to taking an antibiotic?	**Yes**/No
	Question	**Answers**
KNOWLEDGE		
7.	Have you ever skipped a dose	Yes/**No**

	that you went on to make up for?	
8.	If you take antibiotics on your own, the main reasons you do it for are: (multiple responses allowed)	I keep some at home I have studied about antibiotics, so I am informed Someone from my household works in healthcare It is hard to reach a doctor I had a good experience with that antibiotic

Table 1: List of questions and correct (rational) answers. An asterisk (*) denotes a commercial name used in Serbia. Correct (rational) answers are given in **bold**.

Results and discussion

From a total of 380 questionnaires in compilation, 360 were fully answered, giving a response rate of 94.7 per cent. Out of these, 194 (53.9 per cent) were sorted into Group A, rural (students from the surrounding region), and 166 (46.1 per cent) into Group B, urban (students from the university centre). The mean age of the students was 20.3 years, ranging from 18 to 29 years. No statistically significant difference related to the domicile of students was found ($p>0.05$).

Results have been compared against studies that assessed literacy on antibiotics in Serbia, in the immediate region and in other developing countries. Another criterion for comparison was Defined Daily Dose (DDD) per thousand inhabitants, defined by the WHO as the assumed average maintenance dose per day for a drug used for its main indication in adults (World Health Organization, 2017). DDD for Europe ranges between 7.66 in Azerbaijan to 38.18 in Turkey. In Serbia, DDD was 31.57, indicating a very high rate of antibiotics usage. DDD was similarly high in Romania, Greece, Italy, Turkey, Sudan and Montenegro (World Health Organization, 2018: 26–28), and, by some reports, China (Qu *et al.,* 2018). Such comparisons show possible differences in habits regarding consumption of antibiotics in these countries.

Knowledge

We aimed to evaluate whether the students are familiar with basic purposes of treatment with antibiotics, such as their ineffectiveness against viruses, as well as the importance of adherence to dosing regimen. We also wanted to examine whether they are capable of

distinguishing antibiotics from other medicines, as several studies conducted on students have shown that antibiotics are commonly substituted for Non-Steroid Anti-Inflammatory Drugs (NSAIDs), which can be obtained without a prescription. Students' responses to questions on knowledge are summarised in Table 2.

	Question		Answers	
	KNOWLEDGE		**Yes**	**No**
1	Antibiotics are effectively used against (more responses possible):	*Bacteria*	304 (84.4%)	56 (15.6%)
		Viruses	86 (23.9%)	274 (76.1%)
		Fungi	40 (11.1%)	320 (88.9%)
2	Mark the drugs that are antibiotics (more responses possible):	*Ibuprofen*	39 (10.8%)	321 (89.2%)
		Paracetamol	84 (23.3%)	276 (76.7%)
		Probiotic	27 (7.5%)	333 (92.5%)
		Amoxicillin	296 (82.2%)	64 (17.8%)
		Bromazepam	10 (2.8%)	350 (97.2%)
		Penicillin	299 (83.1%)	61 (16.9%)
3	Antibiotics need not be taken in regular intervals, if the daily dosage is respected.		49 (13.6%)	311 (86.4%)
4	Antibiotics help with all types of flu, cough, throat pain, and common cold.		63 (17.5%)	297 (82.5%)
5	Antibiotics can be kept for further usage, if the illness reappears.		119 (33.1%)	241 (66.9%)

Question Answers
KNOWLEDGE Yes No

6	Antibiotics can help with most diseases.	113 (31.4%)	247 (68.6%)
7	Taking antibiotics preventively can immunise us against the common flu.	28 (7.8%)	332 (92.2%)
8	Therapy may be interrupted when the symptoms fade out.	45 (12.5%)	315 (87.5%)

Table 2: Answers to questions on knowledge

The study has shown that students are aware of key points about antibiotics, such as that antibiotics are primarily effective against bacteria. The largest percentage has correctly identified bacteria as the main pathogen treated with antibiotics (84.4 per cent), although with a smaller per cent than students in Nepal (98.2 per cent) (Shrestha, 2019: 76), but larger than in South Jordan (67.2 per cent) (Nawafleh *et al.,* 2017). Nevertheless, as 23.9 per cent identified that antibiotics could kill viruses too, there is room for improvement.

Based on studies conducted in other developing countries, we expected that students would have major doubts when identifying drugs as antibiotics or NSAIDs. However, the result has proven to be largely satisfactory, with largest percentages correctly identifying *Amoxicillin* (82.2 per cent) and *Penicillin* (83.1 per cent) as being antibiotics. This can be explained with available data, as a study conducted in a Serbian hospital catering for approximately 70,000 inhabitants reports penicillin drugs as the most prescribed group of antibiotics. Amoxicillin was the most frequently prescribed individual antibiotic in Serbia in 2017 (Tomic Smiljanic *et al.,* 2017: 245), as well as in Montenegro and Greece (Sahman-Zaimovic *et al.,* 2017: 46; Maltezou *et al.,* 2017: 109).

Significantly lower numbers identified NSAIDs as antibiotics, showing that the students are largely acquainted with the most pertinent examples. Students from Serbia identified *Paracetamol* correctly in 76.7 per cent of cases, whereas studies from Saudi Arabia (Zaidi *et al.,* 2020: 5) have reported large percentages of students mistaking paracetamol for an antibiotic. Therefore, the surveyed students from Serbia can be considered to be aware of the most common examples of antibiotics and can distinguish them well from other commonly used drugs.

A third of surveyed students (33.1 per cent) stated antibiotics may be kept for future use; similarly, a study in neighbouring Croatia conducted on students of health sciences reported that as many as 46 per cent of students and their families kept antibiotics for future use (Aljinovic-Vucic *et al.,* 2005: 76). Only a small percentage (17.5 per cent) believed that antibiotics are effective against all types of flu, common cold and cough, indicating that most students are aware that viral flu cannot be treated with antibiotics. This number is much better than the ones reported by studies from China (at 40.5 per cent) (Zhu *et al.,* 2016: 81) and Turkey (83.1 per cent) (Buke *et al.,* 2005: 135) – a country with a similarly high DDD (38.18 vs. 31.57 in 2015) (World Health Organization, 2018: 45). Most importantly, this number is significantly lower than 58.4 per cent reported by a Serbian study conducted in 2017 on general population (Horvat *et al.,* 2017), showing that the surveyed students have a better idea of what antibiotics should be used for.

Most students studied understand that antibiotics cannot be taken preventively (92.2 per cent) and that it is essential to complete the treatment in its entirety (87.5 per cent). Such numbers have been common in many studies on university students (Kanneppady *et al.,* 2019) and on the general population in Europe, like in Italy (Napolitano *et al.,* 2013). Based on these answers only, it would seem that the students are aware of antibiotic resistance and that they consider that treatment should not be interrupted as soon as signs of relief are shown, as more resistant pathogens may survive and reintroduce the illness. This is, however, not reflected in other answers. Almost a third stated that antibiotics help with most diseases (31.4 per cent). This is quite the opposite of what we wanted to see, as many studies on causes of antibiotic resistance have stated overuse and misconceptions on healing power of antibiotics to be one of the principal causes of resistance development (Machowska and Lundborg, 2018).

The impression is that students from the Serbian sample have a slightly better level of knowledge on antibiotics compared to similar studies from the immediate region, as well as from other developing countries throughout the world. Such results can be partially attributed to the high-school biology curriculum, elaborated in *Rural vs. urban* section below. Still, some questions have yielded conflicting results, indicating possible confusion.

Habits

This section aimed to assess if the students adhere to the principles of rational usage and whether they put the knowledge they have into practice. The questions also aimed to discover whether self-medication was common as in past studies (Horvat *et al.,* 2017; Grigoryan *et al.,* 2010). The answers are summarised in Table 3.

	HABITS	Yes	No
1.	Have you ever acquired antibiotics with no prescription?	215 (59.7%)	145 (40.3%)
2.	Have you ever acquired antibiotics preventively?	17 (4.7%)	343 (95.3%)
3.	Would you consume alcohol during your therapy with antibiotics?	69 (19.2%)	291 (80.8%)
4.	Do you carry an antibiotic when you travel, in case someone falls ill?	225 (62.5%)	135 (37.5%)
5.	Have you ever interrupted your regime before the time prescribed?	165 (45.8%)	195 (54.2%)
6.	Do you always inspect the instruction manual and check the expiry date prior to taking an antibiotic?	261 (72.5%)	99 (27.5%)
7.	Have you ever skipped a dose that you went on to make up for?	120 (33.3%)	240 (66.7%)
			Agree
8.	If you take antibiotics on your own, the main reasons you do it for are: (multiple responses allowed)	I keep some at home	92 (25.6%)
		I have studied about antibiotics, so I am informed	59 (16.4%)
		Someone from my household works in healthcare	88 (24.4%)
		It is hard to reach a doctor	25 (6.9%)
		I had a good experience with that antibiotic	67 (18.6%)

Table 3: Answers to questions on habits

We expected that the section on students' habits would show erroneous usage and self-medication, with less appropriate attitudes present in the rural region. As expected, this section yielded less acceptable results. Ironically, it seems that students' knowledge is not well reflected in practice.

As many as 59.7 per cent of students admitted to acquiring antibiotics without a prescription, which is higher than reported by comparable studies in both Serbia and abroad. The only Serbian study on general public stated that 47.2 per cent of interviewees has admitted to self-medication (Horvat *et al.,* 2017), and in neighbouring Croatia, this number was even lower (37 per cent in 2001, and 41 per cent in 1977) (Aljinovic-Vucic *et al.,* 2005: 76). This shows that, as expected, self-medication with antibiotics is common among surveyed students. Even after introducing stricter regulations in 2011, which forbid selling antibiotics over the counter, antibiotics have been available for purchase without prescription (Tomas *et al.,* 2018). Poor management of private pharmacies and their great autonomy from the Ministry of Health has made it difficult to assess what the most prescribed antibiotics in Serbia truly are and what the rate of purchasing them with no prescription is (Horvat *et al.,* 2018). Our results support the general public opinion that antibiotics may be obtained over the counter easily in Serbia due to inadequate management of pharmacies. One somewhat plausible result regarding acquisition of antibiotics by surveyed students from Serbia is that seldom have they done so preventively (4.7 per cent).

Despite their sound thinking on length of the treatment demonstrated in the *Knowledge* section (Q. 3), 45.8 per cent of students admitted to having prematurely finished their course of antibiotics. This directly contradicts with the rational belief demonstrated in answers to other questions about premature treatment interruption, where 87.5 per cent disagreed that treatment may be interrupted early. Therefore, there is no clear picture on how well the students are acquainted with the severity of antibiotic resistance, illness progression and infection management. While they might be aware of it in theory, their practices do not reflect the knowledge.

Some studies in countries with a similar DDD have reported common premature interruption of treatment (Ghana, Sudan) (Donkor *et al.,* 2012; Sa'adatu Sunusi *et al.,* 2019). In Serbia, 33.3 per cent of surveyed students have reported making up for missed doses, and as many as 62.5 per cent carry antibiotics with them for any emergencies when travelling. According to media reports, these are common practices in Serbia

(Radivojevic, 2019). It is therefore evident that students frequently alter their dosages and do not adhere to their regimens. However, these numbers are better than ones reported in a large study in China, where 70.8 per cent reported interruption of the treatment after first signs of relief (Zhu *et al.,* 2016: 81). In another Chinese study, 55.6 per cent reported taking doses irregularly (Pan *et al.,* 2012).

On the positive side, a large portion of surveyed students would not use alcohol during antibiotic treatment (80.8 per cent). Past studies on Serbian students' attitudes towards alcohol demonstrated that drinking alcohol was a common practice (Kilibarda *et al.,* 2013). In any case, in order to avoid errors that could occur when students who do not drink would answer 'No' as an answer to this question, the statement was given in a hypothetical form. The large percentage of students not taking alcohol during therapy could demonstrate their awareness of reactions of alcohol with some antibiotics and the overall effect of fatigue that alcohol has, as discussed in many official online guides regarding alcohol usage during treatments (Steckelberg, 2018). In our study, we reported a better percentage than the one reported in Tamil Nadu, India (61.4 per cent) (Arul Prakasam *et al.,* 2011). Another satisfactory result is that 72.5 per cent of students stated they always read the instructions and checked the expiry date before usage, which is an important habit in handling any medicine. A similar number (70.8 per cent) was reported in China (Zhu *et al.,* 2016: 81).

The most frequently chosen motive for taking antibiotics without a prescription was keeping leftovers at home (25.6 per cent), in line with the answer that they end their treatments prematurely. Our result is lower than those reported by some older studies in Serbia (46.5 per cent) (Paut Kusturica *et al.,* 2015), possibly indicating a positive outcome of the 2015–16 campaign. Also, this number is significantly lower than the one reported in a similar Chinese study, where 63 per cent of those studied kept antibiotics at home (Peng *et al.,* 2018), but very similar to a study on the general public from neighbouring Romania, a country with a similarly high DDD (31.57 vs. 28.5 in 2015) (World Health Organization, 2018: 28). This study reported 22.9 per cent of respondents using their leftovers from last treatments (Voidazan *et al.,* 2019: 3385), indicating similar habits across the Balkans.

The second most chosen reason is having a medical professional in the household (24.4 per cent). Similar percentages of students trust their experience (18.6 per cent) and knowledge (16.4 per cent). The answers to this question confirm that students tend to

trust their acquaintances, experience and knowledge acquired through high-school education, and indicate that they might consider that some diseases are not worth visiting their doctor about. This reinforces the statement that the opinions of close acquaintances have a high impact on consumer's attitude towards the drug (Akici *et al.,* 2017).

Rural vs. urban: no statistically significant difference

A secondary objective of this study was to inspect differences in answers between students who live in an urban area and those who come from less developed (rural) regions. The *urban area* was defined as the immediate area of the City of Nis, which is the largest urban centre in the studied region and the third-largest city in the country, featuring a large clinical centre, a large primary healthcare centre and 13 municipality-specific primary healthcare centres (Primary Healthcare Centre Nis, 2020). The *less developed – rural area* included the surrounding villages and settlements in Nisava region, which includes a significantly lower number of pharmacies, 12 primary healthcare centres and 27 ambulances with highly irregular working hours dispersed over 163,244 people, according to the 2011 census (Vukmirovic, 2015a: 464; Primary Healthcare Centre Nis, 2020). Students from the urban area benefit from a larger mean parental salary (Statistical Office of the Republic of Serbia, 2020), higher rate of employment in tertiary sector of economy and a higher number of inhabitants with high school or higher education (Vukmirovic, 2015b: 88–89). As such, we expected that urban-area students would score better than their counterparts from the rural region.

However, there was no statistical difference found between the two groups from Nisava region. This shows that awareness of the surveyed students is the same across the region where the university is located, which can be partially attributed to a high-school education system that equally covers antibiotics in most study courses. The official textbooks for biology that were being used at the time when the survey was conducted address the topic equally in the two main study courses available in Serbia. These include the language-humanities study course and the mathematics-natural sciences study course. The chapter on bacteria and viruses describes different types of bacteria, along with most common illnesses they provoke. It outlines the main guidelines of usage of antibiotics and briefly describes antibiotic resistance. While the part on rational usage of the drugs is not very extensive nor puts much emphasis on the global threats of ABR, it

could provide students with some basic knowledge, regardless of places where their high schools were located. This also explains the relatively acceptable results obtained in the section on knowledge.

Additionally, a national campaign conducted in Serbia in 2015–16 managed to bring down the DDD per thousand inhabitants from 36.5 to 30.03 (World Bank, 2018). Despite the age of these students, the campaign could have altered the perception of usage of antibiotics and affected students' attitudes as well. These were the only sources of knowledge we identified that could have influenced these results, as there were no records of newer campaigns addressing antibiotic resistance and consumption.

Limitations and further research

One of the main limitations we encountered was the lack of data on current public health attitudes and practices in Serbia, including data on usage of antibiotics, incidence of infections, as well as availability of antibiotics and any public health strategies or campaigns being implemented. This is due to the scarce treatment of this subject in Serbia and poor pharmaceutical management. The country requires national guidelines on antibiotic use in the outpatient primary care (Horvat *et al.,* 2018). Some information regarding the subject is available in the Serbian language only and as such is inaccessible to the international audience.

This study on its own does not address knowledge on the topic of all young people in the region of similar age, rather it focuses on university students. Our other work refers to the knowledge of students of biomedical sciences and comparison to their colleagues from other fields. This is in line with many similar studies conducted around the world. However, further studies are required to assess the situation in the entire age group, including young people not attending universities. Also, one needs to take into account that students' habits could have easily been influenced by their parents or other members of the family (Akici *et al.,* 2017). Due to the young age of the surveyed sample, their opinions can be easily formed on practices of their elders. As such, further investigations on the general public are needed to assess this link and to design campaigns appropriately.

Conclusions and the future

Despite demonstrating a satisfactory level of knowledge, habits of students regarding usage of antibiotics are not as appropriate. Comparable studies conducted in the developing world and in Serbia have given similar results regarding habits. Students are aware of the antibiotics' mechanism of functioning and can distinguish them well from other types of commonly used NSAIDs. However, many have reported changing their regimens, interrupting them prematurely or taking doses irregularly, as well as buying antibiotics without a prescription. Such behaviour will aggravate the already unfavourable situation in Serbia. Rate of students who acquired antibiotics with no prescription is higher than those in countries with a similar DDD per thousand inhabitants rating.

Students' answers did not demonstrate awareness of the potential dangers and consequences of such actions. No difference was found in relation to the domicile of students, most probably due to common high-school education.

After the 2015–16 campaign, there has been no evidence of new campaigns being implemented, besides occasional closed-circle lectures organised by the Ministry of Health (Ministry of Health of the Republic of Serbia, 2020). International programmes, such as Antibiotic Awareness Week, or European Day of Rational Antibiotic Usage, are not well-promoted in Serbia. For example, the Medical faculty of Nis University has organised a small-scale campaign on ABR only once in the past five years (*Campaign for rational antibiotics usage in Nis,* 2018), despite engaging regularly in public health-related activities such as the World Diabetes Day.

Therefore, new campaigns are necessary across the region to improve students' awareness on the risks of self-medication and ABR. Such campaigns should follow the internationally successful programmes and include greater media coverage, as well as internationally accredited organisations, such as the World Health Organization office in Belgrade. The campaigns should feature informative material distributed over the internet and lectures for youth in collaboration with their centres of education.

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List of tables

References

Akici, A., S. Mollahaliloglu, B. Donertas, D. Ozgulcu, A. Alkan and N. Filiz Basaran (2017), 'Patients' attitides and knowledge about drug use: A survey in Turkish family healthcare centres and state hospitals', *Turkish Journal of Medical Sciences*, 47, 1472–81

Aljinovic-Vucic, V., V. Trkulja and Z. Lackovic (2005), 'Content of home pharmacies and self-medication practices in households of pharmacy and medical students in Zagreb, Croatia: Findings in 2001 with a reference to 1977', *Croatian Medical Journal*, 46 (1), 74–80

Arul Prakasam, K.C., N. Senthil Kumar and J. Ramesh (2011), 'Students' knowledge of antibiotics: A cross-sectional study of students in Tamil Nadu', *International Journal of Pharmacy and Pharmaceutical Sciences*, 3 (1), available at https://innovareacademics.in/journal/ijpps/Vol3Issue1/1100.pdf, accessed 4 April 2020

Aslam, B., W. Wang, M. I. Arshad, M. Khurshid, S. Muzammil, M. H. Rasool, M. A. Nisar, R. F. Alvi, M. A. Aslam, M. U. Qamar, M. K. F. Salamt and Z. Baloch (2018), 'Antibiotic resistance: A rundown of a global crisis', *Infect Drug Resist*, 11, 1645–58

Brookes-Howell, L., G. Elwyn, K. Hood, F. Wood, L. Cooper, H. Goossens, M. Ieven and C. C. Butler (2012), 'The body gets used to them: Patients' interpretations of antibiotic

resistance and the implications for containment strategies', *Journal of General Internal Medicine*, 27 (7), 766–72

Buke, C., M. Hosgorlimoncu, S. Ermertcan, M. Ciceklioglu, M. Tuncel, T. Kose and S. Eren (2005), 'Irrational use of antibiotics among university students', *Journal of Infection*, 51 (2), 135–39

'Campaign for rational antibiotics usage in Nis' (2018), *Naissus Info,* 25 September 2018, available at https://naissus.info/kampanja-za-racionalnu-upotrebu-antibiotika-u-nisu/, accessed 1 September 2020 [in Serbian language]

Donkor, E., P. Tetteh-Quarcoo, P. Nartey and I. Agyeman (2012), 'Self-medication practices with antibiotics among tertiary level students in Accra, Ghana: A cross-sectional study', *International Journal of Environmental Research and Public Health*, 9 (10), 3519–29

Dworkin, B. (2003), 'Microbiology 101: Why antibiotics don't kill viruses', available at http://www.drbarrydworkin.com/articles/medicine/infectious-disease-articles/microbiology-101-why-antibiotics-dont-kill-viruses/, accessed 30 August 2020

Fair, R. J. and Y Tor (2014), 'Antibiotics and bacterial resistance in the 21st century', *Perspect Medicin Chem,* 6, 25⊠64. doi: 10.4137/pmc.s14459

Grigoryan, L., D. Monnet, F. Haaijer-Ruskamp, M. Bonten, S. Lundborg and T. Verheij (2010), 'Self-Medication with antibiotics in Europe: A case for action', *Current Drug Safety*, 5 (4), 329–32

Hawkey, P.M. (1998), 'The origins and molecular basis of antibiotic resistance', *British Medical Journal*, 317 (7159), 657–60

Horvat, O., A. D. Tomas, M. M. Paut Kusturica, A. V. Savkov, D. U. Bukmiric, Z. S. Tomic and A. J. Sabo (2017), 'Is the level of knowledge a predictor of rational antibiotic use in Serbia?', *PLOS One,* 12 (7), available at https://pubmed.ncbi.nlm.nih.gov/28700631/, accessed 30 August 2020

Horvat, O., V. Mijatovic, B. Milijasevic, A. Tomas, M. P. Kusturica, Z. Tomic and A. Sabo (2018), 'Are there striking differences in outpatient use of antibiotics between South Backa District, Serbia, and some Scandinavian countries?' *Frontiers in Public Health,* 6 (91), available at: doi: 10.3389/fpubh.2018.00091, accessed 29 August 2020

Janković, D. (2020), 'Faculties – University of Nis', available at https://ni.ac.rs/en/faculties, accessed 8 April 2020

Kanneppady, S., A. Oo, O. Lwin, A. Ahmed Al-Abed and S. Kanneppady (2019), 'Knowledge, attitude, and awareness of antibiotic resistance among medical students', *Archives of Medicine and Health Sciences*, 7 (1), 57–60

Kilibarda, B., I. Mladenovic and J. Rakic-Gudelj (2013), 'Attitudes on alcohol and drinking patterns among youth in Serbia', *Srpski Arhiv Celokupnog Lekarstva,* 141 (1-2)*,* 66–71

Laxminarayan, R., A. Duse, C. Wattal, A. K. Zaidi, H. F. Wertheim, N. Sumpradit, E. Vlieghe, G. L. Hara, I. M. Gould, H. Goossens, C. Greko, A. D. So, M. Bigdeli, G. Tomson, W. Woodhouse, E. Ombaka, A. Q. Peralta, F. N. Qamar, F. Mir, S. Kariuki, Z. A. Bhutta, A. Coates, R. Bergstrom, G. D. Wright, E. D. Brown and O. Cars (2013), 'Antibiotic resistance-the need for global solutions', *Lancet Infectious Diseases*, 13 (12), 1057–98

Lee Ventola, C. (2015), 'The antibiotic resistance crisis', *Pharmacy and Therapeutics*, 40 (4), 277–83

Lescure, D., J. Paget, F. Schellevis and L. van Dijk (2018), 'Determinants of self-medication with antibiotics in European in Anglo-Saxon countries: A systematic review of the literature', *Frontiers in Public Health,* 6 (370), available at https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6304439/, accessed 02 October 2020

Machowska, A., and C. S. Lundborg (2018), 'Drivers of irrational use of antibiotics in Europe', *International Journal of Environmental Research and Public Health*, 16 (1), 27, available at https://www.mdpi.com/1660-4601/16/1/27/htm, accessed 3 April 2020

Maltezou, H. C., X. Dedoukou, H. Asimaki, I. Kontou, L. Ioannidou, K. Mitromara, K. Theodoridou, P. Katerelos and M. Theodoridou (2017), 'Consumption of antibiotics by

children in Greece: a cross-sectional study', *International Journal of Pediatrics and Adolescent Medicine*, 4 (3): 108–11

Ministry of Health of the Republic of Serbia (2020), 'Rational antibiotic usage and prescription practices in primary healthcare: Antibiotics don't cure the cold nor the flu', available at https://www.zdravlje.gov.rs/vest/345074/racionalna-upotreba-antibiotika-i-propisivacka-praksa-u-primarnoj-zdravstvenoj-zastiti-antibiotici-ne-lece-prehladu-ni-grip.php, accessed on 30 August 2020 [in Serbian language]

Napolitano, F., M. Izzo, G. Di Giuseppe and I. Angelillo (2013), 'Public knowledge, attitudes, and experience regarding the use of antibiotics in Italy', *PLoS ONE*, 8 (12), available at https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0084177, accessed 24 March 2020

Nawafleh, H., M. Momani, L. Hadid and W. Amarat (2017), 'Misuse of antibiotic therapy among university community in South Jordan', *Health Science Journal*, 10 (6), available at https://www.hsj.gr/medicine/misuse-of-antibiotic-therapy-among-university-community-in-south-jordan.php?aid=17874, accessed 27 March 2020

Ocan, M., A. E. Obuku, F. Bwanga, D. Akena, S. Richard, J. Ogwal-Okend and C. Obua (2015), 'Household antimicrobial self-medication: A systematic review and meta-analysis of the burden, risk factors and outcomes in developing countries', *BMC Public Health,* 15 (742), available at https://bmcpublichealth.biomedcentral.com/articles/10.1186/s12889-015-2109-3, accessed 1 October 2020

Ochoa, C., J. Eiros, L. Inglada, A. Vallano, and L. Guerra (2000), 'Assessment of antibiotic prescription in acute respiratory infections in adults', *Journal of Infection*, 41 (1), 73–83.

Pan, H., B. Cui, D. Zhang, J. Farrar, F. Law, and W. Ba-Thein (2012), 'prior knowledge, older age, and higher allowance are risk factors for self-medication with antibiotics among university students in Southern China', *PLoS ONE*, 7 (7), available at http://dx.plos.org/10.1371/journal.pone.0041314, accessed 2 April 2020

Paut Kusturica, M., Z. Tomic, Z. Bukmiric, O. Horvat, N. Pavlovic, M. Mikov and A. Sabo (2015), 'Antibiotics in Serbian households: A source of potential health and

environmental threats?', *Central European Journal of Public Health*, 23 (2), 114–18

Pechère, J.-C., D. Hughes, P. Kardas and G. Cornaglia (2007), 'Non-compliance with antibiotic therapy for acute community infections: A global survey', *International Journal of Antimicrobial Agents,* 29 (3), 245–53

Peng, D., X. Wang, Y. Xu, C. Sun and X. Zhou (2018), 'Antibiotic misuse among university students in developed and less developed regions of China: A cross-sectional survey', *Global Health Action*, 11 (1), available at https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6104601/, accessed 4 April 2020

Petrovic, M. S., R. A. Antonic, B. I. Bagi, I. M. Ilic, A. G. Kocovic, M. N. Milosavljevic, N. M. Nedovic, A. V. Pejcic, M. Z. Vapljanin, A. M. Sabanovic and S. M. Jankovic (2019), 'Inappropriate prescribing of antibiotics to patients with acute bronchitis', *Vojnosanitetski Pregled*, 76 (7), 684–89

Primary Healthcare Centre Nis (2020), 'List and contact of primary healthcare centres and ambulances', available at https://www.domzdravljanis.co.rs/adresar-i-kontakt-telefoni-zdravstvenih-stanica-i-ambulanta/, accessed 30 August 2020 [in Serbian language]

Qu, X., C. Yin, X. Sun, S. Huang, C. Li, P. Dong, X. Lu, Z. Zhang and A. Yin (2018), 'Consumption of antibiotics in Chinese public general tertiary hospitals (2011–2014): Trends, pattern changes and regional differences', *PLoS One*, 13 (5), available at https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0196668, accessed 22 October 2020

Radivojevic, B. (2019), 'Society: do not carry your medicine to the beach', *Vecernje Novosti,* 27 July 2019, available at https://www.novosti.rs/vesti/lifestyle.304.html:808278-Ne-nosite-lekove-na-plazu, accessed 30 August 2020 [in Serbian language]

Sa'adatu Sunusi, L., M. Mohamed Awad, N. Makinga Hassan and C. Abubakar Isa (2019), 'Assessment of knowledge and attitude toward antibiotic use and resistance among students of International University of Africa, Medical complex, Sudan', *Global Drugs and Therapeutics*, 4 (2), available at https://www.oatext.com/pdf/GDT-4-171.pdf, accessed 5 April 2020

Sabuncu, E., J. David, C. Bernède-Bauduin, S. Pépin, M. Leroy, P-Y. Boëlle, L. Watier and D. Guillemot (2009), 'Significant reduction of antibiotic use in the community after a nationwide campaign in France, 2002–2007', *PLoS Med* 6 (6), available at doi:10.1371/journal.pmed.1000084, accessed 12 July 2020

Sahman-Zaimovic, M. , S. Vukmirovic, N. Tomic, N. Stilinovic, O. Horvat and Lj. Tomic (2017), 'Relationship between outpatient antibiotic use and the prevalence of bacterial infections in Montenegro', *Vojnosanitetski pregled*, 74 (1), 46–50

Shama, G. (2015), 'The role of media in influencing public attitudes to penicillin during World War II', *Dynamis,* 35 (1), 131–52

Shrestha, R. (2019), 'Knowledge, attitude and practice on antibiotics use and its resistance among medical students in a tertiary care hospital', *Journal of Nepal Medical Association*, 57 (216), 74–79

Statistical Office of the Republic of Serbia (2020), 'Average monthly earnings by municipality of residence of employees', available at https://data.stat.gov.rs/Home/Result/2403040103?languageCode=en-US, accessed 30 August 2020

Steckelberg, J. M. (2018), 'Can I drink alcohol while taking antibiotics?', available at https://www.mayoclinic.org/healthy-lifestyle/consumer-health/expert-answers/antibiotics-and-alcohol/faq-20057946, accessed 12 July 2020

Tomas, A., M. Paut Kusturica, Z. Tomic, O. Horvat, D. Djurovic Koprivica, D. Bukmirovic and A. Sabo (2018), 'Self-medication with antibiotics in Serbian households: a case for action?', *International Journal of Clinical Pharmacy,* 39(9), available at https://link.springer.com/article/10.1007/s11096-017-0461-3, accessed 02 October 2020

Tomic Smiljanic, M., V. Radonjic and D. Djuric (2017), 'Evaluation of antibiotic consumption at Rakovica Community Health Center from 2011 to 2015', *Serbian Journal of Experimental and Clinical Research,* 18 (3), 245–50

Valent, P., B. Groner, U. Schumacher, G. Superti-Furga, M. Busslinger, R. Kralovics, C. Zielinski, J. M. Penninger, D. Kerjaschki, G. Stingl, J. S. Smolen, R. Valenta, H.

Lassmann, H. Kovar, U. Jaeger, G. Kornek, M. Mueller and F. Soergel (2016), 'Paul Elrich (1856–1915) and his contributions to the foundation and birth of translational medicine', *Journal of Innate Immunity,* 8, 111–20

Voidazan, S., G. Moldovan, L. Voidazan, A. Zazgyva and H. Moldovan (2019), 'Knowledge, attitudes and practices regarding the use of antibiotics. Study on the general population of Mures County, Romania', *Infection and drug resistance,* 12, 3385–96

Vukmirovic, D. (ed.) (2015a), *2011 Census of Population, Households and Dwellings in the Republic of Serbia: Population, age and sex. Data by settlements*, Belgrade: Statistical Office of the Republic of Serbia

Vukmirovic, D. (ed.) (2015b), *2011 Census of Population, Households and Dwellings in the Republic of Serbia: Population, educational attainment, literacy and computer literacy. Data by settlements,* Belgrade: Statistical Office of the Republic of Serbia

World Bank (2018), 'Serbia successfully tackles antimicrobial resistance', available at https://blogs.worldbank.org/health/serbia-successfully-tackles-antimicrobial-resistance, accessed 13 July 2020

World Health Organization (2017), 'Defined Daily Dose', available at https://www.who.int/medicines/regulation/medicines-safety/toolkit_ddd/en/, accessed 30 September 2020

World Health Organisation (2018), *WHO report on surveillance of antibiotic consumption: 2016-2018 early implementation*, Geneva: World Health Organisation

World Health Organization (2020), 'Antibiotic resistance', available at https://www.who.int/news-room/fact-sheets/detail/antibiotic-resistance, accessed 29 September 2020

Zaidi, S., R. Alotaibi, A. Nagro, M. Alsalmi, H. Almansouri, M. A. Khan, A. Khan and I. Memon (2020), 'Knowledge and attitude towards antibiotic usage: A questionnaire-based survey among preprofessional students at King Saud bin Abdulaziz University for Health Sciences on Jeddah Campus, Saudi Arabia', *Pharmacy*, 8 (1), available at https://www.mdpi.com/2226-4787/8/1/5, accessed 2 April 2020

Zhu, X., H. Pan, Z. Yang, B. Cui, D. Zhang and W. Ba-Thein (2016), 'Self-medication practices with antibiotics among Chinese university students', *Public Health*, 130, 78–83

Glossary

Antibiotics: drug class belonging to group of antimicrobials, effective primarily against bacteria.

Antibiotic resistance: capacity of bacteria to develop mechanisms over generations to fight the detrimental effect of antibiotics

Amoxicillin: common antibiotic belonging to the class of β-lactams, used for many bacterial infections such as pneumonia, middle ear infection, skin infections, urinary tract infections

Bromazepam: non-antimicrobial medicine used as an anti-anxiety agent, or as a pre-medicant for minor surgeries

Defined Daily Dose (DDD): assumed average maintenance dose per day for a drug used for its main indication in adults

Global Health: study of health and health issues on a global scale, aiming to improve health and achieve global equity regarding healthcare

Ibuprofen: non-antimicrobial medicine used to treat pain, fever and inflammation

Non-Steroid Anti-Inflammatory Drugs (NSAIDs): drug class used to reduce pain, fever and inflammation, as well as for prevention of blood clots formation. Commonly obtained without a prescription in most countries.

Paracetamol: also known as acetaminophen, a non-antimicrobial drug used to treat mild to severe pain, commonly in children.

Penicillin: wide group of antibiotics derived from Penicillium moulds, discovered by Fleming in 1928. First antibiotic to be discovered. The group also includes amoxicillin.

Probiotics: live microorganism-based medicine or food promoted as improving or restoring the gut flora

Self-medication: usage of medicine without directives from a medical professional, most dangerously of those whose issuing requires prescription. Commonly done with antibiotics

Sensitive target (site): in context of antibiotics, molecular complex on the bacterium attacked by an antibiotic

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Post-Exercise Hot-Water Immersion Promotes Heat-Acclimation Responses in Endurance Athletes and Recreational Athletes: A systematic review and meta-analysis

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Abstract

The fundamental aim of this meta-analysis was to evaluate the effectiveness of post-exercise hot-water immersion as a method of eliciting heat-acclimation responses. The secondary aim was to identify if an intervention period of 5 to 9 days of post-exercise hot-water immersion had any effect on time-trial finishing times in hot environmental conditions. Four databases were used along with two academic search engines to search for studies that satisfied the inclusion criteria. In order to fulfil the inclusion criteria, studies had to be either randomised-control trials or mixed-method design in nature, focusing on hot-water immersion or heat acclimation, with the full text publicly available. Three repeated-measures design studies, two randomised-control trials and one randomised cross-over design study were included. Statistical analysis took place by calculating effect sizes comparing pre- and post-intervention testing for all of the main outcome measures. The main outcome measures were time to complete a predetermined treadmill-based time trial, during-exercise heart rate and post-exercise heart rate, rectal temperature, physiological strain index and thermal sensation.

Once the effect sizes had been calculated, they were graphically represented using forest plots heterogeneity tests in Meta-Essentials Excel software package.

The results of the meta-analysis indicate that a 5- to 9-day protocol of post-exercise hot-water immersion reduces: time taken to complete a treadmill-based time trial, heart rate (-9 BPM ± 1.3), rectal temperature (-0.38 ± 0.03 °C). Additionally, sweat rate increased by 0.09 litres. Changes in ratings of perceived exertion, physiological heat strain index and thermal sensation were considered statistically significant. There was no difference between endurance-trained and recreationally trained individuals in relation to changes in ratings of perceived exertion as a result of heat training. However, the time delay between when exercise was conducted and when hot-water immersion occurred significantly impacted measures of thermal sensation.

Keywords: Heat strain index, time-trial performance, heat-acclimation protocols, plasma volume, thermoregulatory responses

Introduction

Acute exercise in hot environmental conditions increases physiological strain; inducing an increase in whole-body temperature leading to thermal discomfort, increased cardiovascular strain, perception of exertion and impairment of aerobic capabilities (Casa *et al.,* 2015; Racinais *et al.,* 2015; Young *et al.,* 1985;). However, long-term exposure to heat stress intensifies thermoregulatory responses, enhances submaximal exercise performance, improves maximal oxygen uptake (VO_{2max}) (Guy *et al.,* 2016; Tyler *et al.,* 2016), improves skin blood flow response, and increases sweat rate and plasma expansion (Racinais *et al.,* 2015; Chong and Zhu, 2017) while mitigating the effect of thermal discomfort.

To counteract the impacts of thermal strain and the cardiovascular limitations associated with acute exposure to exercising in hot conditions (Chong and Zhu, 2017), athletes and individuals often partake in heat-acclimation protocols aimed to improve exercise performance in hot environmental conditions (Guy *et al.,* 2016). Newly emerging research suggests that the ergogenic benefits of exercise-focused heat acclimation may extend further than just improving exercise performance in hot conditions. By undergoing a heat-acclimation protocol an individual's exercise performance in cool conditions can also be improved (Zurawlew *et al.,* 2016; Pryor *et al.,* 2019), However, further research is required.

Extensive research has been conducted evaluating the different methods to overcome the physiological limitations encountered while exercising in hot conditions. (Altareki *et al.,* 2009; Cheuvront *et al.,* 2010; Jentjens *et al.,* 2002; Schulze *et al.,* 2015; Tatterson *et al.,* 2000) Heat acclimatisation is the process by which physiological adaptations occur in response to naturally occurring heat stress – for example, seasonal heat adaptation. However, heat acclimation is defined as the process where a series of complex changes and adaptations occur in response to heat stress where the source of thermal stress is derived from an artificial source – for example, hot-water immersion and environmental chambers (Nielsen, 1998). While pre-exercise cooling strategies can often provide a much more economically viable solution when compared to more expensive heat-acclimation strategies, the overall successfulness of pre-exercise cooling is often sub-par (Quod *et al.,* 2008; Ross *et al.,* 2011).

While heat-acclimation protocols may be the norm for professional athletes, they are arguably not the ideal method for amateur athletes with limited time away from work and family commitments. There are a variety of limitations that come with acclimatisation protocols for

amateur athletes. There are many limitations of warm-weather training camps; one primary limitation is the psychological effect experienced from being away from friends and family for a potentially unnecessary amount of time, which may lead to a decrease in physiological wellbeing (Thornton *et al.,* 2018). Thus, it is evident that a heat-acclimation protocol may not be the best thermal-stress mitigation strategy for armature athletes. Consequently, it can be argued that amateur athletes will benefit more from completing a heat-acclimation protocol with an artificially controlled heat stress source such as hot-water immersion. Hence, this study will perform a quantitate evaluation on the effectiveness of post-exercise hot-water immersion regarding its ability to produce the physiological effects normally associated with heat training.

One newly emerging method of heat-acclimation training is post-exercise hot-water immersion, which previous research has claimed to result in similar responses to other heat-training methods. Fox *et al.* (1963) were one of the first to publish research in this area, focusing on passive heat acclimation using a form of controlled hyperthermia via a vapour barrier suit. However, these methods were somewhat limited in regard to their practicality and reported no change to thermoregulatory responses during exercise heat stress. Newer research provides support for the theory of post-exercise hot-water immersion, suggesting that in non-heat-acclimated individuals, a 10- to 14-day period of hot-water immersion decreased core temperature at rest before and during hot-water immersion (Brazaitis and Skurvydas, 2010). With limited research on this topic, and differing protocols used, it is unclear what the exact effects of post-exercise hot-water immersion are and what the best protocol is for the desired physiological response. Hence, this study will perform a quantitative evaluation on the effectiveness of post-exercise hot-water immersion regarding its ability to produce the physiological effects that are normally associated with heat training.

Methods

Search strategy

A systematic literature search on articles published up to 6 April 2020 was carried out in the databases PubMed (MEDLINE), Scopus, SPORTDisscus and Web of Science. Additionally, academic search engines Google Scholar and ResearchGate were used. A search strategy was developed based on the Pico model (da Costa Santos *et al.* 2007; Eriksen and Frandsen, 2018).

The Pico model is an evidence-based process used for framing a question, adopting the following system: identifying a problem, creating an intervention, comparing pre- and post-intervention, and measuring the outcome of interest. The Boolean operators ‘AND’ and ‘OR’

were used to search the following terms: ‘postexercise’, ‘heat acclimation’, ‘hot water immersion’, ‘hot environmental conditions’ and ‘endurance exercise’.

Diagram

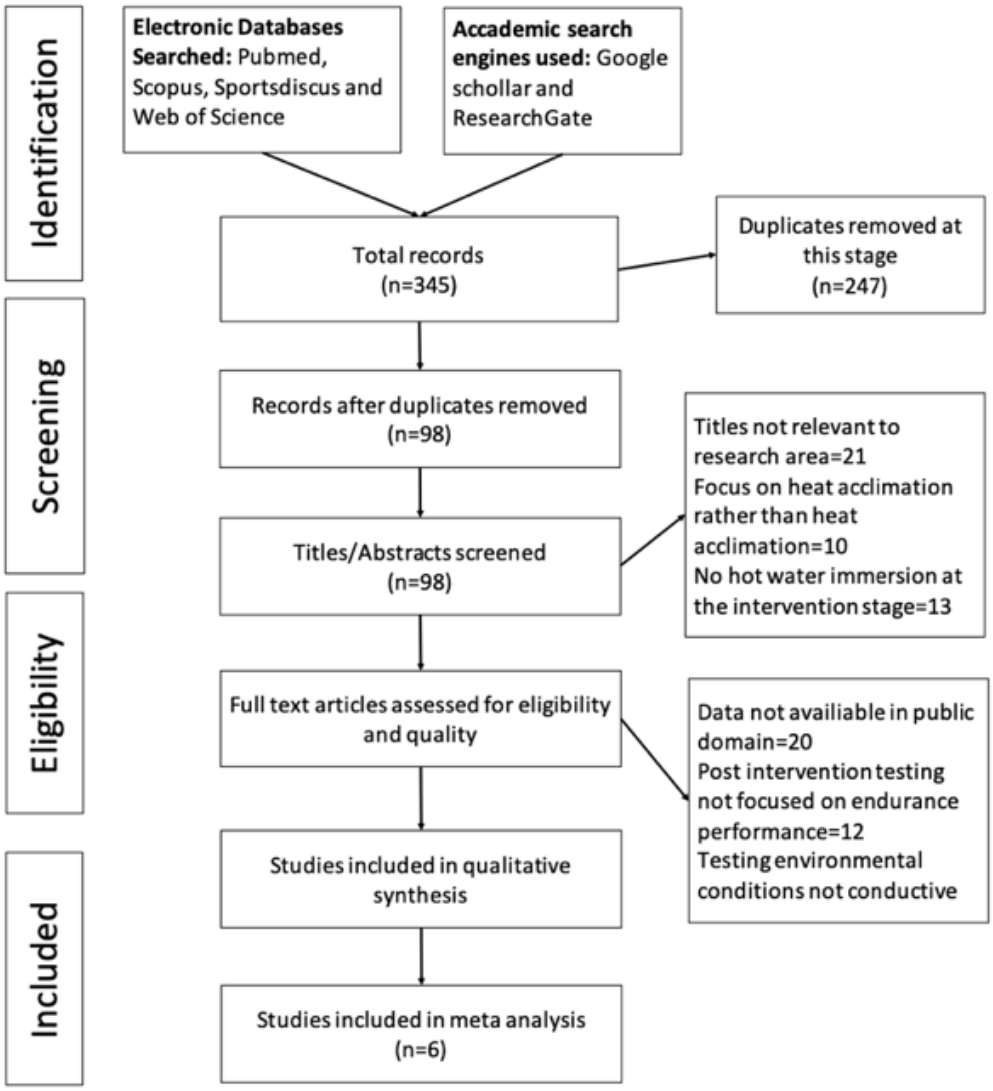

Figure 1: Prisma flow diagram

Criteria	Yes	No	Other (CD,NR,NA)
Is the review based on a focused question that is adequately formulated and described?			
Were eligibility criteria for included and excluded studies predefined and specified?			
Did the literature search strategy use a comprehensive, systematic approach?			
Were titles, abstracts and full-text articles dually and independently reviewed for inclusion and exclusion to minimise			

Criteria Yes No Other (CD,NR,NA)

independently reviewed for inclusion and exclusion to minimise bias?
Was the quality of each included study rated independently by two or more reviewers using a standard method to appraise its internal validity?
Were the included studies listed along with important characteristics and results of each study?
Was publication bias assessed?
Was heterogeneity assessed? (This question applies only to meta-analyses.)

Table 1: NIH Quality Assessment Tool for Systematic Reviews and Meta-Analyses *(*National Heart, Lung and Blood Institute, n.d.)
Note: The green boxes represent yes when answering the proposed question and the red boxes represent the no option.

The NIH Quality Assessment Tool for Systematic Reviews and Meta-Analyses (National Heart, Lung and Blood Institute, n.d.) was used during the planning and preparation of this review to ensure that the scientific rigour of this systematic review and meta-analysis was as high as possible. This involved forming a strict primary hypothesis and data-collection protocol as well as using the most up-to-date data analysis methods and assessing for heterogeneity.

Selection criteria

The previously specified search strategy yielded a net result of 345 articles. After removing duplicate studies, this came to a total of 98 titles. Titles and abstracts were reviewed to determine whether studies fulfilled the selection criteria. Studies were eligible for inclusion if they met the following criteria: (1) articles must be written in English and must have been published between 2010 and 2020; (2) wet-heat acclimation must be included as a primary intervention during the study; (3) studies needed to be of a pre–post design with a significant time duration (> 6 days) of the selected intervention method; (4) studies had to include an experience-based measurement to quantify the effects of the heat-acclimation protocol, for example time-trial performance or similar aerobic fitness testing protocol; (5) a full-text version of the study had to be publicly available with public access to all data used within the study.

Subsequently, the studies selected were based on the Prisma checklist constructed by Moher *et al.,* 2009. Studies were excluded if the participants were already stated to be heat acclimatised or had undergone any form of thermal training in the previous three months. Articles were only

included in the full-text review if it was deemed that their title and abstract met the fundamental demands of the inclusion criteria. After the final selection, the total possible articles came to 54. All eligible papers were then screened via analysing the full text. At this stage, several articles were removed due to data not being in the public domain, despite efforts attempting to contact the authors.

Quality assessment

After analysing all 54 identified articles and narrowing down the selection at each stage of reviewing the articles, a total of 6 were included due to being randomised and controlled in their design (as reported in Figure 1). Using a modified version of the 11-step Pedro scale (Eriksen and Frandsen, 2018; Moher *et al.,* 2009; Brazaitis and Skurvydas, 2010), the studies were assessed for any possible risk of biases and overall quality.

Study quality

Study quality and reporting were assessed using the validated TESTEX scale (Smart *et al.,* 2015) (Figure 2). This scale consists of a validated 15-point scale, which evaluates the randomised-control trial elements of the study (total 5 points available for this section), and the quality of data and information reporting within the study (total 10 points available for this section). A study with a TESTEX quality score of less than 10 was deemed to be low quality.

Data extraction and statistical analysis

For all the articles that met the initial inclusion criteria, basic information and data were extracted into a standardised Excel spreadsheet, which included: sample size, study design, study location, intervention vs control sample size, intervention vs control methods, and control vs experimental heat-testing conditions. Additionally, an enhanced data-extraction process occurred with the aim of conducting a meta-analysis. The data fields for this included: all usable data regarding the study's hot-water immersion protocol (immersion duration, temperature, frequency and time implemented post-exercise as well as the number of participants able to complete the immersion at each stage of the intervention), cool and hot environmental testing conditions, (ambient temperature and humidity) and pre-intervention testing protocol (exercise(s) test used, familiarisation protocols). The raw data from pre-intervention testing and post-intervention testing were included. To ensure a high level of quality control during the data-extraction phase, data was extracted in duplicates. In the event that the statistical findings were unclear, a second data reviewer would be appointed to reach a consensus regarding the outcome of the data-extraction and statistical-analysis phase.

The meta-analysis was conducted by exporting all accessible raw data for all outcome measures into a customised spreadsheet and then importing the data into the Meta-Essentials Excel software packages version 1 (Suurmond, van Rhee and Hak, 2017). Subsequently, all data was analysed using one of three analysis tools of the software package, either: (1) Meta-Essentials Effect Size data, (3) Meta-Essentials Difference between independent groups – continuous data (for randomised-control trials study designs) or (4) Meta-Essentials Difference between dependent groups – continuous data (for other study designs). Data analysis was also split between raw data (e.g. pre- and post-intervention) and effect size compared to baseline data (baseline data was not published in the studies with this data type). The meta-analysis was presented using forest plots and publication bias, and a 5 per cent level of significance was applied to illustrate the significance of the results. Standardised mean difference was calculated using the standardised mean-difference effect size (d) calculator designed by Curlette (1987).

Heterogeneity

To evaluate the heterogeneity among the studies, the I2 statistic (Borenstein *et al.,* 2017) was employed with values >50 per cent demonstrating substantial heterogeneity (Higgins *et al.,* 2003). Equally, the risk of publication bias was analysed by using the Egger plot (Egger *et al.,* 1997). Most analysis of heterogeneity depends on the number of trials included in a meta-analysis, which is usually small, and this limits the statistical power of the test. Therefore, the 95 per cent confidence interval was chosen (Huedo-Medina *et al.,* 2006; Thompson and Sharp, 1999).

	Brazaitis and Skurvydas 2010	Zurawlew *et al.* 2016	Zurawlew *et al.* 2018a	Zurawlew *et al.* 2018b	Heathcote *et al.* 2019	Zurawlew *et al.* 2019
Eligibility criteria specified	1	1	1	1	1	1
Randomisation details specified	1	1	1	1	1	1
Allocation concealed	1	1	0	0	1	0
Groups similar at baseline	1	1	1	1	1	1
Assessors	1	0	1	0	1	1

blinded						
Outcome measures assessed >85 per cent participants	3	3	2	3	2	2
Intention to treat analysis	1	1	1	1	1	1
Reporting between-group statistical comparison	1	1	1	0	1	0
Point measures & measures of variability	1	1	1	1	1	1
Activity monitoring in control group	1	1	0	0	1	0
Relative exercise intensity constant	1	1	1	1	1	1
Exercise volume & energy expenditure	1	1	1	1	1	1
Overall TESTEX score (/15)	14/15	13/15	11/15	10/15	13/15	10/15

Table 2: TESTEX study quality table

The inclusion criteria produced five repeated-measures design studies and one mixed-methods study that were considered for meta-analysis. All chosen studies were published in the period from 2010 to 2019. The sample size varied between 1 to 13, with all participants being completely informed of what was involved in their respective study. There was large variability in both the level of weekly physical activity and self-determined physical ability.

Results

The inclusion criteria produced five repeated measure design studies and one mixed-methods study that were considered for meta-analysis. The studies included in the meta-analysis were Brazaitis and Skurvydas, 2010, Zurawlew *et al.* 2016, Zurawlew *et al.* 2018a, Zurawlew *et al.* 2018b, Heathcote *et al.* 2019 and Zurawlew *et al.* 2019. All included studies were published between 2010 and 2019. Sample sizes varied between 1 to 13, which resulted in a total of 66 participants (60 males and 6 females) with the mean age of all participants 25.8 ± 4.7. Participants' sporting habits varied between classified as healthy recreational individuals to healthy well-trained individuals competing in endurance sports such as triathlon and marathons.

The primary outcome measures of the meta-analysis were: difference in time-trial finishing time (in seconds) where time-trial completion time was measured using a treadmill-based time trial; changes in heart rate (BPM), including during-exercise heart rate (HRe); heart rate following hot-water immersion (HRhwi); changes to body temperature when measured using either core temperature (T°C), mean skin temperature (Ts°C) or rectal temperature (Tre°C). The psychological perception of heat stress was measured using the following scales: physiological strain index (PSI) (Moran *et al.,* 1996); thermal sensation was determined according to the 5-point scale (Kraessig, 1978) or an eight-point scale. (Moran *et al.,* 1996), and the rating of perceived exertion (RPE) is included in studies where RPE was measured using the Borg and Kaijser (2006) scale.

Changes in heart rate following heat-acclimation training

Six studies (eight sub-groups) were evaluated to see the change in heart rate following heat acclimation (Figure 2) with five sub-groups reporting that heat acclimation has a significant effect on heart rate. By undergoing a prolonged period (6–9 days) of hot-water immersion-based heat-acclimation training, during-exercise heart rate was reduced by ~-7 BPM. Additionally, end-of-exercise heart rate was reduced by ~-10 BPM.

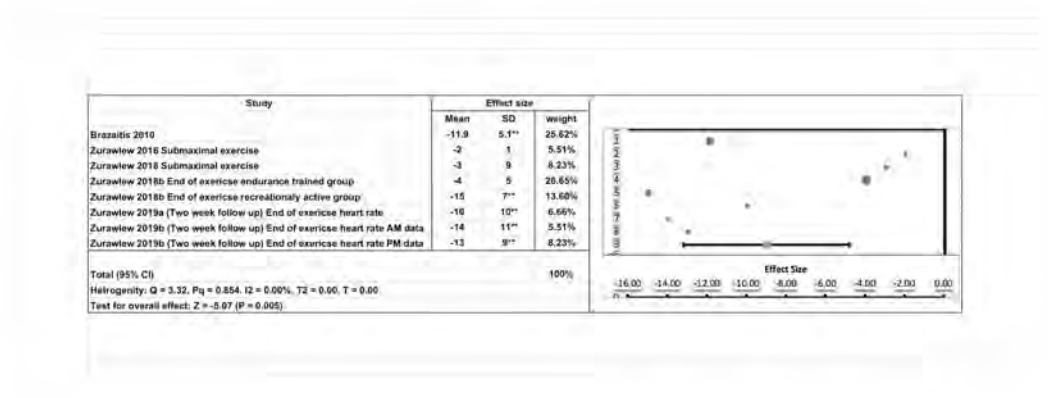

Figure 2: Changes in heart rate after a prolonged heat-acclimation training protocol

The difference in size between the circles indicates the level of effect of post-exercise hot-water immersion when taking into account the sample size of the study. The larger circles with a negative effect size number represent a study with a larger sample size where the intervention method has had the desired response.

The effect of repeated post-exercise hot-water immersion on rectal temperature

Repeated post-exercise hot-water immersion exposure resulted in a small but statistically significant decrease in rectal temperature (Figure 3). The results from the Forrest plot indicate that all sub-groups reported a decrease in this outcome measure. However, the results show rectal temperature is reduced significantly more post-exercise than during exercise following heat-acclimation training.

End-of-exercise rectal temperature decreased by -0.8 Tre°C, compared to during-exercise rectal temperature, which changed by only -0.3 Tre°C. This suggests that post-exercise hot-water

immersion-based heat training has a significant effect on both during and end-of-exercise rectal temperature, but that end-of-exercise Tre is reduced to a greater extent.

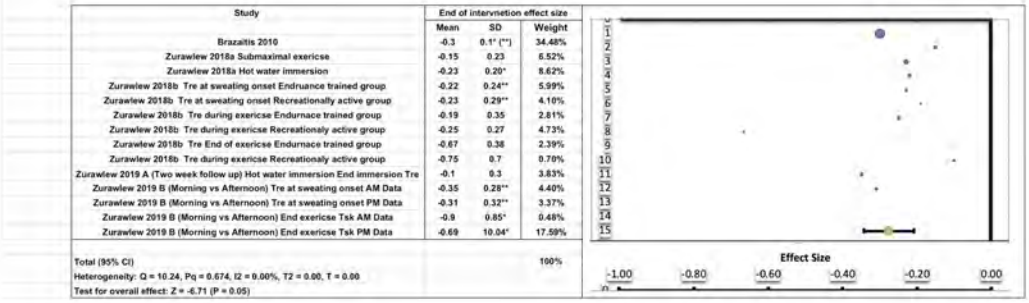

Figure 3: Changes in rectal temperature following wet-heat acclimation training.

Change in Tre compared to baseline testing.

Zurawlew *et al.* (2018b; 2019) reported Tre°C at sweating onset point; however, Zurawlew *et al.* (2018a; 2018b; 2019) reported mean Tre during and after the whole testing protocol. A total of five studies displayed Tre data with 14 sub-groups included in this analysis. Eight sub-groups reported a significant difference for Tre after heat-acclimation, (SMD, -0.3814 Tre°C).

Changes in sweat rate following a series of hot-water immersion-based heat-training protocols

The heat-training protocol resulted in an increase in sweat rate which was reported in Zurawlew *et al.,* 2016, Zurawlew *et al.,* 2018a and Zurawlew *et al.,* 2018b afternoon (PM) data. However, the Zurawlew *et al.,* 2019 morning (AM) data sub-group reported a decrease in sweat rate

following heat training. This suggests that sweat rate is likely to increase following heat-acclimation training protocols as expressed in previous literature.

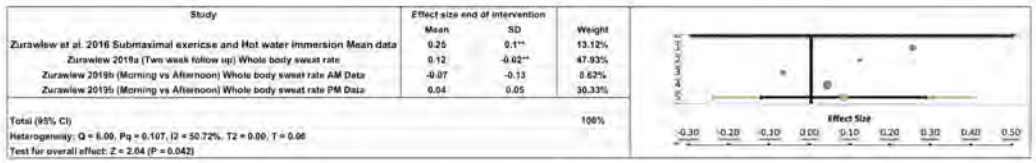

Figure 4: Changes in sweat rate following heat-acclimation training

Change in sweat rate following heat acclimation is displayed in Figure 4. The effect of heat acclimation on sweat rate was reported in three studies; nonetheless, owing to sub-groups in the studies, a total of four sub-groups reported data for changes in sweat rate. Figure 4 displayed the SMD changes in sweat rate (litres per hour) with one sub-group reporting a significant difference after completing heat acclimation, (SMD, 0.085).

The effect of repeated post-exercise hot-water immersion protocols on rating of perceived exertion (RPE) during submaximal exercise

A series of hot-water immersion-based heat-training sessions resulted in a statistically significant decrease in RPE during submaximal exercise performance when compared to the baseline data. Three sub-groups out of a total of nine reported results that were of a statically

significant level; however, two sub-groups did report that RPE did not change as a result of the heat-training protocols.

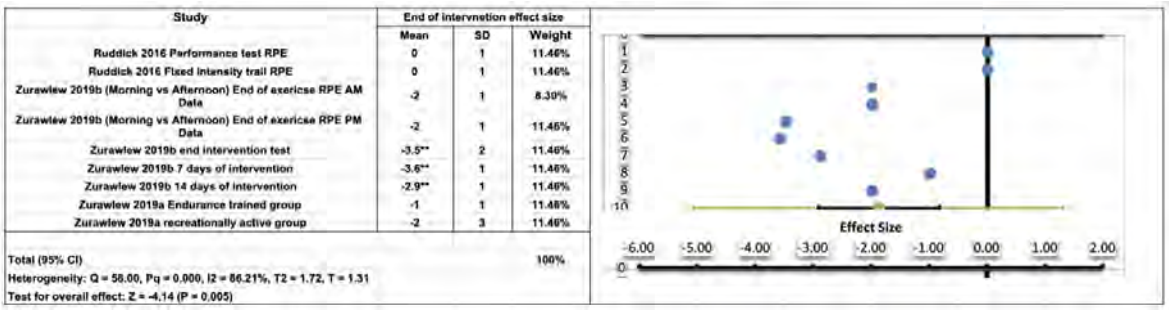

Figure 5: Changes in RPE following heat-acclimation training

Changes in RPE are displayed in Figure 5 The effect of wet-heat training was reported in four studies, with a total of nine sub-groups reporting data. The standardised mean difference for all included sub-groups was -1.8 (SMD -1.8).

Changes in physiological heat strain index (PSI) after following a six-day wet-heat training protocol

Figure 6 displays the results from a meta-analysis regarding the effects of post-exercise hot-water immersion on PSI. Measures of thermal strain were conducted in one study with a total of four sub-groups reporting data. Two studies reported results that were statistically significant, demonstrating that a six-day period of wet-heat acclimation is able to significantly reduce the sensation of physiological heat strain.

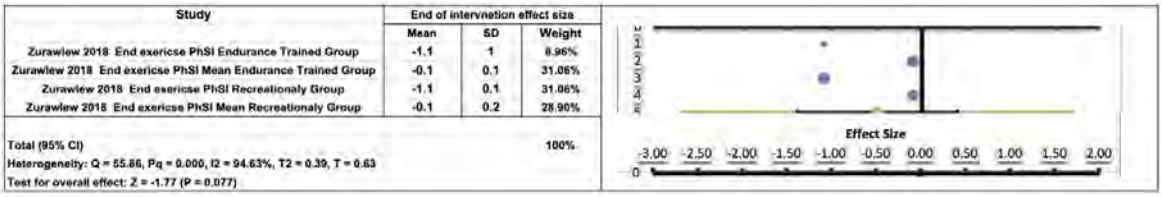

Figure 6: Changes in physiological heat strain index following heat-acclimation training

Four sub-groups, all from one study, reported findings regarding the effect of post-exercise hot-water immersion on changes in PSI. Two of the sub-groups reported results that were considered statistically significant. The SMD for this measure was calculated to be -0.6.

Changes in thermal sensation after a series of wet-heat acclimation training sessions are displayed in Figure 7. The analysis of the included Heathcote *et al.,* (2019) sub-groups suggests that the greatest change in thermal sensation occurs when hot-water immersion is conducted

within 1 hour of exercise. Both the 10-minute time gap and the 1-hour time gap between exercise and hot-water immersion resulted in similar decreases in thermal sensation (10-minute time gap -1.8; 1-hour time gap -1.9).

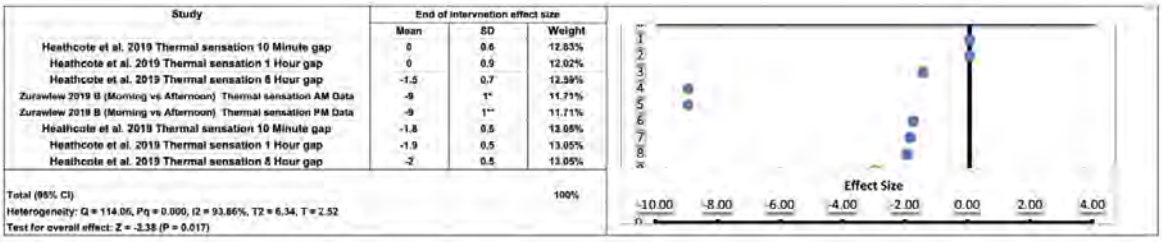

Figure 7: Changes in thermal sensation following heat-acclimation training

Three studies reported findings relating to thermal sensation, but owing to sub-groups, a total of eight databases were analysed. Only the study of Zurawlew *et al.* (2019) reported statically significant results in the sub-groups *morning* vs *afternoon* thermal sensation (AM and PM) data. The standardised mean difference for all included sub-groups was reported as -3.15.

Discussion

This systematic review and meta-analysis aimed to update the available literature by using only recently published studies (2010–2020) on the outcome measures associated with thermoregulatory adaptations attributed to post-exercise hot-water immersion during athletic performance. (Tebeck *et al.,* 2019).

The results from this meta-analysis suggest that wet-heat acclimation (in this case post-exercise hot-water immersion) resulted in similar physiological adaptations to dry-heat acclimation (Horstman and Christensen, 1982*et al.,*; Moran *et al.,* 1996; Tebeck *et al.,* 2019). Prior research has shown that a prolonged period of heat training (>14 days) decreases heart rate during exercise in hot conditions of up to 37°C (Casa *et al.,* 2015; Guy *et al.,* 2016; Racinais *et al.,* 2015). This meta-analysis supports these claims with post-exercise hot-water immersion training reducing exercise heart rate by -9 BPM (SMD). Previous literature has equally shown that following a >14–day period of heat training, a decrease in rectal temperature is experienced during and post-exercise as a result of increased heat tolerance (Cheung and McLellan, 1998; Pandolf, 1979). This theory is equally supported by the statistical findings of this meta-analysis, which concluded that following a 1- to 2-week period of heat training, rectal temperature decreased by (SMD) -0.3814 Tre (°C).

Prior research has demonstrated that for dry-heat acclimation, a prolonged period of >14 days is optimal for achieving the greatest rate of heat acclimation. However, the results from this meta-analysis show that with wet-heat acclimation, the greatest rate of adaptation is achieved after six days. Therefore, it can be advised that the rate of heat adaptation is quicker for hot-water immersion when compared to dry heat-acclimation methods.

Time-trial finishing time

An analysis of 5-km treadmill time-trial performance in hot environmental conditions following a 14-day period of heat-acclimation training

The analysis of time-trial performance reports that a 14-day period of post-exercise hot-water immersion training significantly improves performance in both thermoneutral (18°C) and hot (33°C) experimental conditions (Figure 8). The performance improvement was significantly greater in hot (33°C) conditions with participants reporting a 5 per cent timesaving compared to their control time with no heat-training time. During hot environmental conditions (33°C) time-trial performance testing the pre-intervention time was 1321 ± 219s with the post-intervention time being 1299 ± 207s. The mean difference between pre-intervention and post-intervention time-trial finishing time was 22s. This suggests that post-exercise hot-water immersion has a significant effect on reducing the time taken to complete a 5-km treadmill time trial in both thermoneutral (18°C) and hot (33°C) environmental conditions.

Figure 4.

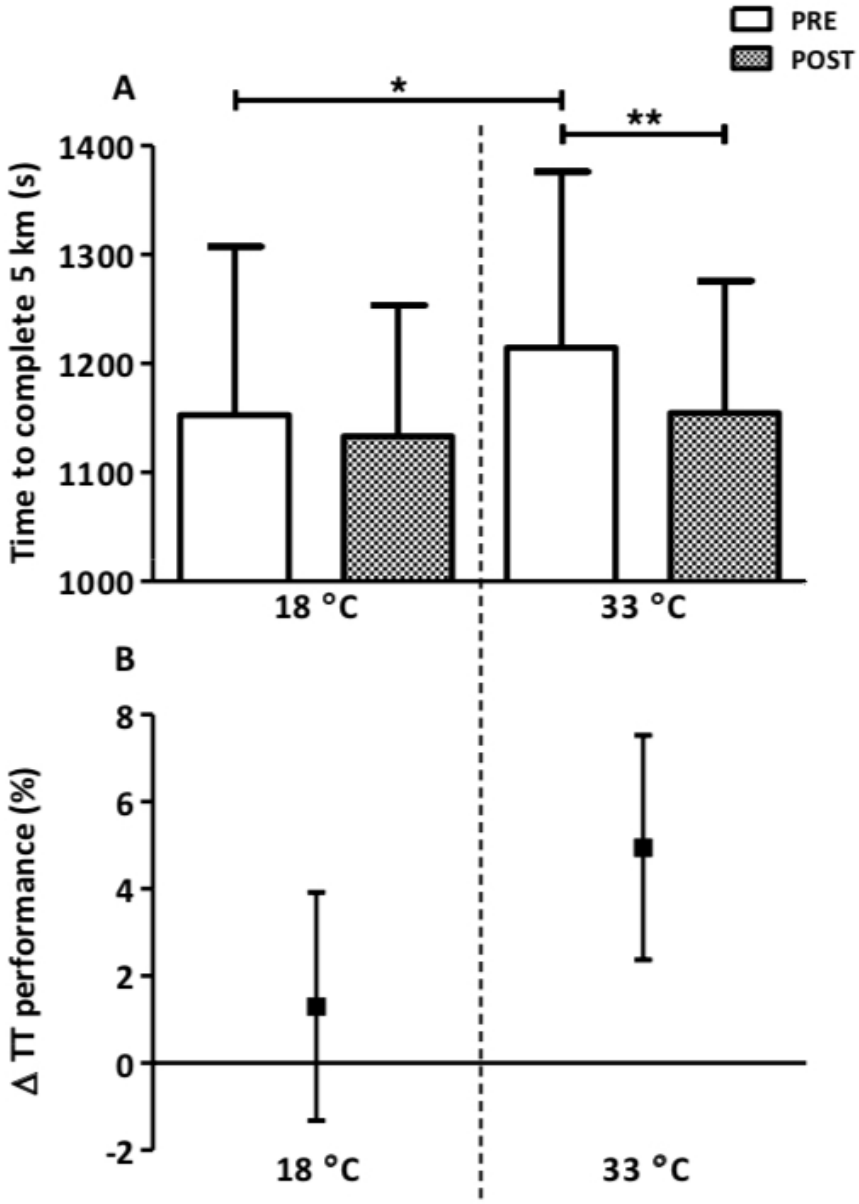

Figure 8: Influence of a six-day post-exercise hot-water immersion protocol on 5-km treadmill time-trial performance (Zurawlew *et al.*, 2016) (A); Treadmill time-trial finishing time in 18°C (40 per cent humidity) and 33°C (40 per cent humidity) (B) per cent change in 5-km treadmill time-trial finishing time. Graph (A) shows mean and SD. Graph (B) shows mean and 90 per cent CI of the differences. * $p < 0.05$ and ** $p < 0.01$. Reprinted with permission from Zurawlew *et al.* (2016) and the publisher *John Wiley and Sons*.

The results indicate that a prolonged period of post-exercise hot-water immersion had a significant effect on time-trial finishing times. The statistical findings generated by Zurawlew

et al. (2016) supports previous theories. Tyler *et al.* (2016) reported a 4 per cent improvement in both submaximal cycling performance and race-walking performance. In the review conducted by Tyler *et al.,* it was stated that longer intervention periods were more successful than shorter intervention periods (7 days). The findings of Zurawlew *et al.* (2016), which relate to 5-km running performance, report that even shorter periods of wet-heat acclimation training (6 days) are equally effective at reducing the time taken to complete a predefined distance. This provides supporting evidence that shorter heat-acclimation protocols can be equally effective at improving endurance performance in hot conditions when compared to longer heat-training protocols.

Heart rate

The changes in mean heart rate during submaximal exercise, hot-water immersion, performance testing and end of exercise decreased significantly for all heat-acclimation groups compared to the values shown during pre-intervention testing. The mean decrease for all heart rate outcome measures was reported as -9 BPM (as displayed in Figure 2). The control groups experienced no decrease in these outcome measures during post-intervention testing (Lorenzo *et al.,* 2010). While previous studies have reported mixed results regarding the changes in resting or during-exercise heart rate after short-term heat acclimation (Willmott *et al.,* 2016), this meta-analysis does not support those theories and instead reported that following a short-duration heat-acclimation protocol (5–9 days), heart rate measures decrease by approximately 22 per cent similar to the findings of Périard *et al.* (2015) and Périard *et al.* (2016) (Figure 9). The mean effect size for all heart rate data collected was -9 (BPM). It can be argued that the passive heat stimulus during hot-water immersion generated a significant reduction in cardiovascular strain in recreationally active individuals (Brazaitis and Skurvydas, 2010; Convertino, 1991) and thus, recreationally active individuals may experience a larger improvement in key outcome measures as a result of hot-water immersion heat-acclimation protocol compared to highly trained individuals.

These results were expected based on the previous literature supporting the theory that recreationally active participants would experience a greater reduction in heart rate compared to the endurance-trained group. This suggests that individuals who have a lower training history (e.g. recreationally trained) are likely to receive a more significant effect from heat training compared to individuals with a greater training history.

Rectal temperature (Tre°C)

The reduction in rectal temperature is critical to athlete performance because having an increased body temperature can inhibit aerobic performance (Lim *et al.,* 2008). Therefore, if heat-acclimation training decreases core body temperature when exercising in hot conditions, there is a potential to improve exercise performance in the heat.

These statistical findings support the data and theories proposed in previous studies concerning the physiological effects of heat-acclimation training. The results of this meta-analysis (Figure 3) support the theories of prior research indicating that heat acclimation has a statistically significant effect on Tre (Tyler *et al.,* 2016). The authors demonstrated a moderate-to-large reduction in during- and post-exercise Tre after completing a heat-acclimation protocol (Tyler *et al.,* 2016). These findings support the results of this meta-analysis. Zurawlew *et al.* (2018a) stipulated that as a consequence of their habitual exercise training, endurance-trained individuals are considered to be further along the heat adaptation consortium than recreationally active individuals; thus reducing their total adaptation potential (Tyler *et al.,* 2016). This explains why the recreationally active group experienced a greater decrease in heart rate following heat acclimation, SMD, -4 (BPM) (endurance-trained sub-group) compared to -15 (BPM) (recreationally active sub-group) (Data can be seen in Figure 3).

Rating of perceived exertion (RPE), physiological heat strain index (PSI) and thermal sensation

The change in RPE, PSI and thermal sensation following heat acclimation were all considered to be statistically significant. Prior research has resulted in mixed results regarding the effect of heat-acclimation training on thermal sensation metrics while exercising in hot conditions (Chong and Zhu, 2017; Périard *et al.,* 2015; Racinais *et al.,* 2015).

The changes in RPE were the greatest when compared to the other methods of measuring the psychological and physiological effects of thermal discomfort. There was no difference between the endurance-trained sub-group and the recreationally active sub-group regarding the change in the PSI, with both sub-groups reporting a change of -1.1 for the PSI. However, there was a statistically significant change between the two sub-groups for the RPE, with the endurance-trained sub-group reporting a change of -1 and the recreationally active sub-group reporting -2. Tyler *et al.* (2016) reported heat acclimation had a moderate impact on RPE and a small impact on thermal sensation. The outcome measure *thermal sensation* is a crucial stimulus that drives voluntary behaviour such as self-selected exercise performance and capability. Thus, future research may focus on ways to improve thermal sensation measures through hot-water immersion heat-acclimation protocols.

Sweat rate

The change in sweat rate was not considered statistically significant due to the analysis resulting in mixed results with Zurawlew *et al.* (2019) AM data reporting a small decrease in sweat rate (-0.07 litres per hour). However, only one of the other sub-groups reported results that were statistically significant (Zurawlew (2016) reported an increase of 0.25 litres per hour) The other two sub-groups reported small increases in sweat rate that were too small to be considered statistically significant (Zurawlew (2019) 0.12 litres per hour and Zurawlew (2019) PM data 0.04 litres per hour). Therefore, it has to be claimed that the results seen in this meta-analysis regarding the changes in sweat rate do not support claims made in previous studies which have suggested that heat training can increase sweat rate (Roberts *et al.,* 1977 and Magalhães *et al.,* 2010).

The results indicate that post-exercise hot-water immersion promotes similar physiological responses to those normally associated with conventional heat training (Périard *et al.,* 2016). Figure 9 (adapted with permission from Périard *et al.,* 2015), shows a graphical representation of the physiological adaptations experienced as a result of heat-acclimation training over a 14-day time frame. As can be seen from the graph, the rate of adaptation is different depending on the nature of the physiological adaptation. Thus, some adaptations may be experienced after only three or four days of heat acclimation, whereas other changes may take up to six or seven days to be fully experienced. The data also suggests that some physiological adaptations reach a limit of progression after a set number of days irrespective of the number of future heat training experienced. One example of this can be viewed in heart rate. The changes in heart rate start rapidly, but after day six, no future changes are experienced. This suggests that the level of change for some physiological adaptations is not in direct proportion to the total number of days of heat-acclimation training.

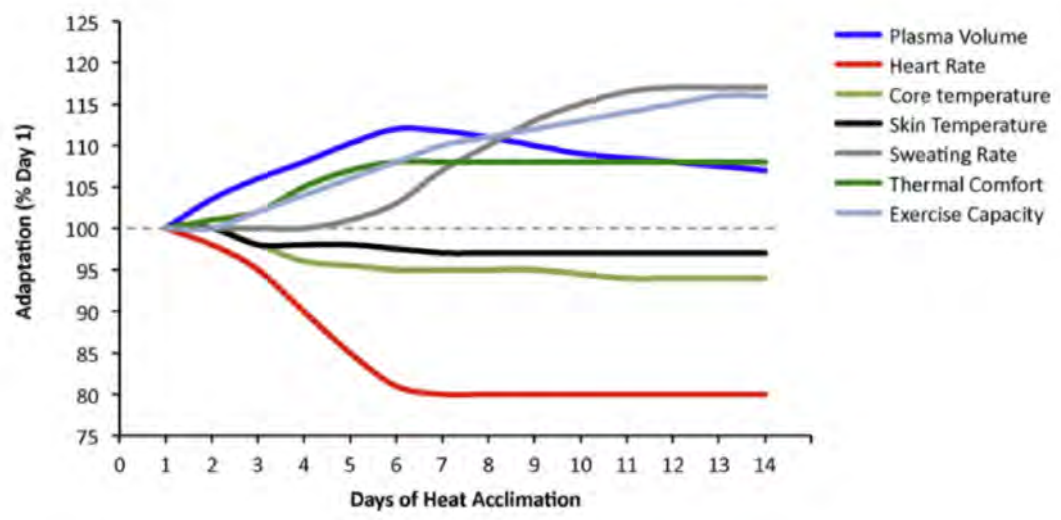

Figure 9: A 14-day time course of human adaptations and responses to heat stress (Reprinted with permission from Périard *et al.* 2015 and the publisher John Wiley and Sons)

Conclusions and extensions

These findings support the original findings of James *et al.* (2018); Périard *et al.* (2016); Racinais *et al.* (2015) and Reeve *et al.,* (2019).

The data suggests that for individuals at all competition levels, there is a significant performance benefit that comes as a result of performing a post-exercise hot-water immersion protocol that has a heat-acclimation focus (Chong and Zhu, 2017; Guy *et al.,* 2016; Périard *et al.,* 2016). However, amateur athletes and individuals with a shorter training history are likely to experience a greater performance improvement compared to high-level athletes.

In addition, the findings presented in this study can and should be used in conjunction with other strategies to overcome performance limitations that occur via exercising in hot conditions. One example of this is to use the protocol outlined in this study with other pre-existing pre-exercise cooling methods such as ice vests (Jones *et al.,* 2012; Quod *et al.,* 2008), and the oral ingestion of cold liquids (Périard *et al.,* 2016; Ross *et al.,* 2011). The findings presented in this study are of particular relevance to endurance athletes and sports scientists looking to develop strategies to mitigate the extreme environmental conditions that are likely to occur during the Tokyo 2021 Olympic and Paralympic games.

Limitations

One minor limitation of the study is that only one of the included studies had female participants (Brazaitis and Skurvydas, 2010). However, it should be argued that the results seen in this meta-analysis can still be applied to females. This is because recent studies (Kaciuba-Uscilko and Grucza, 2001; Iyoho *et al.,* 2017) have shown that there is no difference in heat adaptation and thermoregulation between male and females. Instead the rate of heat adaptation is linked to body surface area and surface mass ratio and, thus, the rate of heat adaptation is not dependant on gender (Notley *et al.,* 2017).

Secondly, only two studies were randomised-control trials in nature, and due to the design characteristics for the study, the sample sizes are small (n=9 to n=17). This argues that more randomised-control trials and repeated-measures studies with larger samples sizes are needed to provide more definitive results. Finally, regarding the process of data collection, the mean differences between pre- and post-intervention were calculated. However, in the cases where accurate *p* values within or between groups or 95 per cent CI were unavailable, default *p* values were employed, and this could have impacted the reported results. Egger plots suggest a minimal chance of publication bias, indicating there may not be negative, publicly available datasets in existence. Despite this, the limited number of studies may negatively affect the relevance of Egger plots in this analysis.

Conclusion

Hot-water immersion protocols focused on heat acclimation decrease time-trial finishing time, heart rate during exercise, HRM, HRe, HRhwi, Tre during exercise and decrease measures of heat stress including rating of perceived exertion, physiological heat strain index and thermal sensation.

For the purpose of practical recommendations, it should be advised that hot-water immersion protocols should last between 6 and 10 days (Shin *et al.,* 2013; Zurawlew *et al.,* 2016), hot-water immersion should take place directly after approximately 40 minutes of submaximal exercise (Heathcote *et al.,* 2019; Zurawlew *et al.,* 2016) and hot-water immersion should consist of 40 minutes immersed up to neck at 40°C, for best results.

Recommendations for future research

This meta-analysis has shown that hot-water immersion heat acclimation has a positive impact on exercise performance in both hot (28°C+) and thermoneutral environmental conditions (12–18°C). However, there are several elements still unclear regarding hot-water immersion heat-acclimation protocols. One recommendation for future research is to identify a way of

measuring the total psychological strain experienced by an individual during hot-water immersion heat-acclimation protocols. It has been widely stated that hot-water immersion heat-acclimation protocols have a training effect on the human body; however, there has not yet been a validated method of accounting for the psychological stress induced by such heat-acclimation protocols. A system similar to that of training stress score/heart rate training stress score would be extremely useful to athletes and coaches attempting to implement hot-water immersion heat-acclimation protocols into training schedules.

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The author reports no conflicts of interest.

List of illustrations

Figure 8: Influence of a six-day post-exercise hot-water immersion protocol on 5-km treadmill time-trial performance (Zurawlew *et al.,* 2016) (A); Treadmill time-trial finishing time in 18°C (40 per cent humidity) and 33°C (40 per cent humidity) (B) per cent change in 5-km treadmill time-trial finishing time. Graph (A) shows mean and SD. Graph (B) shows mean and 90 per cent CI of the differences. * $p < 0.05$ and ** $p < 0.01$. Reprinted with permission from Zurawlew *et al.* (2016) and the publisher *John Wiley and Sons*.

Figure 9: A 14-day time course of human adaptations and responses to heat stress (Reprinted with permission from Périard *et al.* 2015 and the publisher John Wiley and Sons)

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Table 1: NIH Quality Assessment Tool for Systematic Reviews and Meta-Analyses

Table 2: TESTEX study quality table

References

Altareki, N., B. Drust, G. Atkinson, T. Cable and W. Gregson (2009) 'Effects of environmental heat stress (35 degrees C) with simulated air movement on the thermoregulatory responses during a 4-km cycling time trial', *International Journal of Sports Medicine*, 30 (1), 9–15.

Borenstein, M., J. P. Higgins, L. V. Hedges and H. R. Rothstein (2017), Basics of meta–analysis: I2 is not an absolute measure of heterogeneity', *Research Synthesis Methods*, 8 (1), 5–18.

Borg, E. and L. Kaijser (2006) 'A comparison between three rating scales for perceived exertion and two different work tests', *Scandinavian Journal of Medicine & Science in Sports*, 16 (1), 57–69.

Brazaitis, M. and A. Skurvydas (2010) 'Heat acclimation does not reduce the impact of hyperthermia on central fatigue', *European Journal of Applied Physiology*, 771–78. doi: 10.1007/s00421-010-1429-3.

Casa, D., J. DeMartini, M. Bergeron, D. Csillan, E. Eichner, R. Lopez, M. Ferrara, K. Miller, F. O'Connor, M. Sawka, and S. Yeargin, (2015) 'National Athletic Trainers' Association position statement: Exertional Heat illnesses', *Journal of Athletic Training*, 50 (9), 986–1000.

Cheung, S. S. and T. M. McLellan (1998) 'Heat acclimation, aerobic fitness, and hydration effects on tolerance during uncompensable heat stress', *Journal of Applied Physiology*, 84 (5), 1731–39.

Cheuvront, S., R. Kenefick, S. Montain and M. Sawka (2010) 'Mechanisms of aerobic performance impairment with heat stress and dehydration', *Journal of Applied Physiology*, 109 (6), 1989–95.

Chong, D. and N. Zhu (2017) 'Human heat acclimatization in extremely hot environments: A review', *Procedia Engineering*, 248–253. doi: 10. 1016/j. proeng. 2017. 09. 960.

Convertino, V. A. (1991) 'Blood volume', *Medicine & Science in Sports & Exercise*, 1338–48. doi: 10. 1249/00005768–199112000–00004.

Curlette, W. L. (1987) 'The Meta-Analysis Effect Size calculator: A basic program for reconstructing unbiased effect sizes', *Educational and Psychological Measurement*, 107–09. doi: 10. 1177/0013164487471012.

da Costa Santos, C. M., C. A. de Mattos Pimenta and M. R. C. Nobre (2007) 'The PICO strategy for the research question construction and evidence search', *Revista Latino-Americana de Enfermagem*, 15 (3), 508–511.

Egger, M., G. Smith, M. Schneider and C. Minder (1997) 'Bias in meta-analysis detected by a simple, graphical test', *BMJ*, 629–634. doi: 10. 1136/*BMJ*. 315. 7109. 629.

Eriksen, M. B. and T. F. Frandsen (2018) 'The impact of patient, intervention, comparison, outcome (PICO) as a search strategy tool on literature search quality: a systematic review', *Journal of the Medical Library Association: JMLA*, 106 (4), 420–31.

Fox, R., R. Goldsmith, D. Kidd and H. Lewis (1963), Acclimatization to heat in man by controlled elevation of body temperature. *The Journal of Physiology*, 166 (3), 530-547.

Guy, J., D. Pyne, G., Deakin, C. Miller and A. Edwards (2016) 'Acclimation training improves endurance cycling performance in the heat without inducing endotoxemia', *Frontiers in Physiology*, 7, 318.

Heathcote, S., P. Hassmén, S. Zhou, L. Taylor and C. Stevens (2019) 'How does a delay between temperate running exercise and hot-water immersion alter the acute thermoregulatory response and heat-load?', *Frontiers in Physiology*, 10, 1381.

Higgins, J. P., S. G. Thompson, J. J. Deeks and D. G. Altman (2003) 'Measuring inconsistency in meta-analyses', *BMJ*, 327 (7414), 557–60.

Horstman, D. H. and E. Christensen (1982) 'Acclimatization to dry heat: Active men vs. active women', *Journal of Applied Physiology*: *Respiratory, environmental and exercise physiology*,

52 (4), 825–31.

Huedo-Medina, T. B., J. Sánchez-Meca, F. Marín-Martínez and J. Botella. (2006) 'Assessing heterogeneity in meta-analysis: Q statistic or I2 index?', *Psychological Methods*, 193–206. doi: 10. 1037/1082–989x. 11. 2. 193.

Iyoho, A. E., L. J. Ng, and L. Macfadden (2017) 'Modeling of gender differences in thermoregulation', *Military Medicine*, 295–303. Doi: 10. 7205/milmed-d-16-00213.

James, C. A., A. J. Richardson, P. W., Watt, A. G. Willmott, O. R. Gibson and N. S. Maxwell (2018) 'Short-term heat acclimation and precooling, independently and combined, improve 5-km time trial performance in the heat', *Journal of Strength and Conditioning Research / National Strength & Conditioning Association*, 32 (5), 1366–75.

Jentjens, R. L. P. G., A. J. M. Wagenmakers, and A. E. Jeukendrup (2002) 'Heat stress increases muscle glycogen use but reduces the oxidation of ingested carbohydrates during exercise', *Journal of Applied Physiology*, 92 (4), 1562–72.

Jones, P. R., C. Barton, D., Morrissey, N. Maffulli and S. Hemmings (2012) 'Precooling for endurance exercise performance in the heat: A systematic review', *BMC Medicine*. doi: 10. 1186/1741-7015-10-166.

Kaciuba-Uscilko, H. and R. Grucza (2001) 'Gender differences in thermoregulation', *Current Opinion in Clinical Nutrition and Metabolic Care*, 533–536. doi: 10. 1097/00075197-200111000-00012.

Kraessig, H. (1978) 'Clothing comfort – interaction of thermal, ventilation, construction and assessment factors', *Journal of Polymer Science: Polymer Letters Edition*, 249–49. doi: 10. 1002/pol. 1978. 130160509.

Lim, C. L., C. Byrne, and J. K. Lee, (2008), 'Human thermoregulation and measurement of body temperature in exercise and clinical settings', *Annals Academy of Medicine Singapore*, 37 (4), 347.

Lorenzo, S., J. R. Halliwill, M. N. Sawka and C. T. Minson (2010) 'Heat acclimation improves exercise performance', *Journal of Applied Physiology*, 1140–47. doi: 10. 1152/japplphysiol. 00495. 2010.

Magalhães, F. C., R. L. Passos, M. A., Fonseca, K. P. Oliveira, J. B. Ferreira-Júnior, A. R. Martini, M. R. Lima, J. B. Guimarães, V. G. Baraúna, E. Silami-Garcia and L. O. Rodrigues (2010)

'Thermoregulatory efficiency is increased after heat acclimation in tropical natives', *Journal of Physiological Anthropology*, 29 (1), 1–12.

Moher, D., A. Liberati, J. Tetzlaff, D. G. Altman and Prisma Group (2009) 'Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement', *Annals of Internal Medicine*, 151 (4), 264–69, W64.

Moran D., Y. Shapiro, U. Meiri, A. Laor and M. Horowitz (1996) 'Heat acclimation: cardiovascular response to hot/dry and hot/wet heat loads in rats', Jo*urnal of Basic and Clinical Physiology and Pharmacology*, 7 (4), 375–87.

National Heart, Lung and Blood Institute, (2020) 'Study Quality Assessment Tools | NHLBI, NIH', available at https://www. nhlbi. nih. gov/health-topics/study-quality-assessment-tools, accessed 28 October 2020.

Nielsen, B. (1998) 'Heat acclimation – Mechanisms of adaption to exercise in the heat', *International Journal of Sports Medicine*, S154–S156. doi: 10. 1055/s-2007-971984.

Notley, S. R., J. Park, K. Tagami, N. Ohnishi, and N. A. Taylor (2017) 'Variations in body morphology explain sex differences in thermoeffector function during compensable heat stress', *Experimental Physiology*, 102 (5), 545–62.

Pandolf, K. B. (1979) 'Effects of physical training and cardiorespiratory physical fitness on exercise-heat tolerance: recent observations', *Medicine and Science in Sports*, 11 (1), 60–65.

Périard, J. D., G. J. Travers, S. Racinais and M. N. Sawka (2016) 'Cardiovascular adaptations supporting human exercise-heat acclimation', *Autonomic Neuroscience: Basic & Clinical*, 196, 52–62.

Périard, J. D., S. Racinais, and M. N. Sawka (2015) 'Adaptations and mechanisms of human heat acclimation: Applications for competitive athletes and sports', *Scandinavian Journal of Medicine & Science in Sports*, 25 Suppl 1, 20–38.

Pryor, J. L., E. C. Johnson, W. O. Roberts and R. R. Pryor (2019) 'Application of evidence-based recommendations for heat acclimation: Individual and team sport perspectives', *Temperature (Austin, Tex.)*, 6 (1), 37–49.

Quod, M. J., D. T. Martin, P. B., Laursen, A. S. Gardner, S. L., Halson, M. P. Tate, D. E. Mainwaring, C. J. Gore and A. G. Hahn (2008) 'Practical precooling: effect on cycling time trial performance in warm conditions', *Journal of Sports Sciences*, 26 (14), 1477–87.

Racinais, S., J. D. Périard, A. Karlsen and L. Nybo. (2015) 'Effect of heat and heat acclimatization on cycling time trial performance and pacing', *Medicine and Science in Sports and Exercise*, 47 (3), 601–06.

Reeve, T., R. Gordon, P. B. Laursen, J. K. Lee and C. J. Tyler (2019) 'Impairment of cycling capacity in the heat in well-trained endurance athletes after high-intensity short-term heat acclimation', *International Journal of Sports Physiology and Performance*, 14 (8), 1058–65.

Roberts, M. F., C. B. Wenger, J. A. Stolwijk and E. R. Nadel (1977) 'Skin blood flow and sweating changes following exercise training and heat acclimation', *Journal of Applied Physiology: respiratory, environmental and exercise physiology*, 43 (1), 133–37.

Ross M. L. R., L. A. Garvican, N. A. Jeacocke, P. B. Laursen, C. R. Abbiss, D. T. Martin, L. M. Burke (2011) 'Novel precooling strategy enhances time trial cycling in the heat', *Medicine and Science in Sports and Exercise*, 43 (1), 123–33.

Schulze, E., H. A. Daanen, K., Levels, J. R. Casadio, D. J. Plews, A. E. Kilding, R. Siegel, and P. B. Laursen (2015) 'Effect of thermal state and thermal comfort on cycling performance in the heat', *International Journal of Sports Physiology and Performance*, 10 (5), 655–63.

Shin, Y. O., J. B. Lee, Y. K. Min and H. M. Yang (2013) 'Heat acclimation affects circulating levels of prostaglandin E2, COX-2 and orexin in humans', *Neuroscience Letters*, 542, 17–20.

Smart, N. A., M. Waldron, H. Ismail, F. Giallauria, C. Vigorito, V. Cornelissen and G. Dieberg (2015) 'Validation of a new tool for the assessment of study quality and reporting in exercise training studies: TESTEX', *International Journal of Evidence-Based Healthcare*, 13 (1), 9–18.

Suurmond, R., H. van Rhee, and T. Hak (2017), 'Introduction, comparison, and validation of Meta–Essentials: A free and simple tool for meta-analysis', *Research Synthesis Methods*, 8 (4), 537–553.

Tatterson, A. J., A. G. Hahn, D. T. Martini and M. A. Febbraio (2000) 'Effects of heat stress on physiological responses and exercise performance in elite cyclists', *Journal of Science and Medicine in Sport / Sports Medicine Australia*, 3 (2), 186–93.

Tebeck, S. T., J. D. Buckley, C. R. Bellenger and J. Stanley (2019) 'Differing physiological adaptations induced by dry and humid short-term heat acclimation', *International Journal of Sports Physiology and Performance*, 1–24.

Thompson, S. G. and S. J. Sharp (1999) 'Explaining heterogeneity in meta-analysis: a comparison of methods', *Statistics in Medicine*, 2693–2708. doi: 3. 0. co;2–v">10. 1002/

(sici)1097–0258 (19991030)18:20<2693::aid-sim235>3. 0. co;2–v.

Thornton, H. R., J. A. Delaney, G. M. Duthie and B. J. Dascombe (2018) 'Effects of preseason training on the sleep characteristics of professional rugby league players', *International Journal of Sports Physiology and Performance*, 13 (2), 176–82.

Tyler, C. J., T. Reeve, G. J. Hodges and S. S. Cheung (2016) 'The effects of heat adaptation on physiology, perception and exercise performance in the heat: A meta-analysis', *Sports Medicine*, 1699–1724. doi: 10. 1007/s40279-016-0538-5.

Willmott, A. G. B., O. R. Gibson, M. Hayes and N. S. and Maxwell (2016) 'The effects of single versus twice daily short term heat acclimation on heat strain and 3000m running performance in hot, humid conditions', *Journal of Thermal Biology*, 56, 59–67.

Young, A. J., M. N. Sawka, L. Levine, B. S. Cadarette, and K. B. Pandolf (1985) 'Skeletal muscle metabolism during exercise is influenced by heat acclimation', *Journal of Applied Physiology*, 59 (6), 1929–35.

Zurawlew, M. J., N. P. Walsh, M. B. Fortes and C. Potter (2016) 'Postexercise hot water immersion induces heat acclimation and improves endurance exercise performance in the heat', *Scandinavian Journal of Medicine & Science in Sports*, 26 (7), 745–54.

Zurawlew, M. J., J. A. Mee, and N. P. Walsh (2018a) 'Heat acclimation by postexercise hot-water immersion: Reduction of thermal strain during morning and afternoon exercise-heat stress after morning hot-water immersion', *International Journal of Sports Physiology and Performance*, 1–6.

Zurawlew, M. J., J. A. Mee, and N. P. Walsh (2018b) 'Postexercise hot water immersion elicits heat acclimation adaptations in endurance trained and recreationally active individuals', *Frontiers in Physiology*, 9, p. 1824.

Zurawlew, M. J., J. A. Mee, and N. P. Walsh (2019) 'Postexercise hot water immersion elicits heat acclimation adaptations that are retained for at least two weeks', *Frontiers in Physiology*. doi: 10. 3389/fphys. 2019. 01080.

Glossary

Adaptation: A positive change in the biological system in response to external loading and adequate subsequent recovery

Heat acclimation: The physiological adaptations associated with prolonged exposure to high environmental temperatures

Meta-analysis: A type of scientific study that statistically analyses pooled data from a number of previous scientific studies that address the same question.

VO_{2max}: Maximal oxygen uptake, defined as the maximum amount of oxygen in millilitres that a person can use in one minute measured per kg of body weight

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Exhibition Review: *Pandemic objects: Photograph* – The way eye see it

Sarah Sullivan, Monash University

The exhibition *Pandemic objects: Photograph*, written by Duncan Forbes in collaboration with independent curator Marcela Chao (https://www.vam.ac.uk/blog/projects/pandemic-objects-photograph), reflects upon the tragic consequences of the widespread coronavirus in Mexico City. What is unique about this particular exhibition is the lens through which it views how information is communicated in the twenty-first century – through photography. Given physical galleries are now closed due to the COVID-19 pandemic, virtual exhibitions offer a more private viewing of these images. This can create a sense of intimacy within viewers, but also it reduces audience attendees due to a lack of awareness of this new digital format.

The virtual exhibition from the Victoria and Albert Museum begins with a full A4-sized image of three individuals wearing masks with the words 'I can't breathe' written with a black, thick marker. The photo is stretched horizontally across the page, deliberately catching viewers' attention and directing their focus to the centre of the page. This image does exactly what the corresponding text discusses: it offers a deliberately confronting scene. The exhibition uses a balance between textual information and images, which interrupts the heaviness of the writing and creates a pictorial representation of a moment in time. The slogan 'I can't breathe' is an interesting and clever choice to incorporate because it has become so recognisable in our information-driven world. The exhibit draws correlations between the excessive use of force used by police officers against George Floyd and the 'structural inequalities' in Mexico's healthcare system that lead many people to experience serious breathing difficulties as a result of the coronavirus. The writer and curator's ability to combine both separate issues – police treatment of African Americans and limited medical resources – is a significant highlight of this exhibition and should be positively viewed. The statement in the *Pandemic objects: Photograph* exhibition – 'pandemic photography continues to generate new meanings with lightning speed' – reiterates how photography has enabled these cross-connections and new ways of perceiving the world.

The inclusion of black and white photographs from the 1890s depicting a former health pandemic, the Bubonic Plague, helps to establish a chronology of events up until the present. Personal pandemic photography is employed here to establish a more 'intimate' view of society during this health crisis. The exhibit also compares digital photographs to deadly diseases, illustrating their speed of online transmission. The visual evidence of this global disaster is being captured easily and distributed quickly within minutes via social media channels.

There are three images included within the exhibition that stand out to me: two health care officials dressed in full PPE walking the streets; a bare supermarket shelf except for one product in Los Angeles, and an official sign indicating physical distance measures in an empty street in Mexico City. These photos are emotionally evocative because they capture and freeze an unprecedented moment in history. The bareness of these locations visually highlights the devastation this pandemic has caused right across the globe. The close-up shots are still images, yet they share this sense of heartbreak and unknowing despair that viewers have already probably experienced in their own lives. The simplicity of the photos adds to the overall mood of the exhibition, using common everyday routines such as grocery shopping and walking in the streets as activities that have been profoundly impacted by this virus. This links back to the title of the exhibition, narrowing focus upon the physical objects that are memorable during this period of human history. Therefore, this selection of photos is very important and relatable for viewers.

The photographs of the streets really emphasise how fragile human beings are, because our absence has not affected the surrounding urban environment. Tall buildings are positioned as looming structures high in the sky, reinforcing humanity's inferiority to both nature and construction. Whether this was a conscious choice by the curator or not, I still believe this is significant to note.

The exhibition largely places personal imagery within the Mexican context, using photography to display 'the uneven impact of the virus'. The textual component reveals the reality on the ground, mentioning body bags being sold for families with deceased loved ones and dangerous shortages of protective equipment. The accompanying image shows a masked man standing behind a counter with what appears to be plastic wrap stretched across the front of the register to protect him from customers. While this image is dreadfully sad, I'm unsure as to whether it's the most powerful photograph that could

have been selected for the exhibit. Images of families could have humanised the imagery further and appeared more candid, rather than a still portrait photo. Nevertheless, this is a very minor criticism of what is overall a highly engaging and thought-provoking online exhibit.

This exhibit deserves to be praised for its selection of very poignant photographs, some immediately noticeable and others less so. All photographs and incorporated text form their own individual stories as part of the global narrative that is documenting the COVID-19 pandemic.

Source

Duncan Forbes, 'Pandemic Objects: Photographs', *Victoria and Albert Museum*, available at https://www.vam.ac.uk/blog/projects/pandemic-objects-photograph, accessed 23 October 2020

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Pandemic Objects: TikTok Review

Alice Kunjumon, Monash University

How did TikTok become so popular? Harriet Reed's piece *Pandemic Objects: TikTok* very successfully demonstrates the bridge between twenty-first century TikTok and the 1930's 'The Lambeth Walk' dance; exploring how dance unites humanity in the face of unprecedented and difficult times (https://www.vam.ac.uk/blog/projects/pandemic-objects-tiktok). This is part of the *Pandemic Objects* online exhibition in the Victoria and Albert Museum, which was published on 7 June 2020. Reed, Assistant Curator at the museum, wrote this piece, adding to her previous work relating to theatre and performance art, utilising a mixed medium of videos, photographs and posters.

The current popularity behind TikTok, and that of 'novelty dance', has its beginnings much further back in history than social media, and has been compared to the great phenomenon of the spread of the Charleston during the 1920s. 'The Lambeth Walk' continued to be a phenomenon even during World War II where people attended dances even with the threat of being bombed, and wearing gas masks, symbolising the 'resilience' of people during times of conflict; and parallels can be seen in the use of TikTok to cope with the COVID-19 pandemic. The text linking these parallels is accompanied by posters of musical advertisements from the 1920s and 30s and YouTube videos demonstrating how 'The Lambeth Walk' was performed. These visuals stimulate our imagination by elaborating on our knowledge of both the historical and societal context, further emphasising how World War II and 'The Lambeth Walk', and COVID-19 pandemic and TikTok are similarly significant.

Reed also demonstrates the significance of 'The Lambeth Walk' through the witty, edited video of Adolf Hitler and his soldiers 'performing' to the dance. She connects this 1941 video to our modern-day memes, showing how people use humour to handle perplexing times.

The opening black and white photograph of the girls laughing as their friend dances somehow resonates with the modern-day entertainment of TikTok, whereby such encouragement and affirmation is given in the form of 'likes' as you press the red heart sign on the TikTok app.

Reed provides an overview of TikTok, giving us an insight into the popularity and significance of this app to cleverly show how it uses our short attention span to create entertainment. As we listen to the YouTube videos of various TikToks linked in the exhibition, it's almost humorous to think that we are also caught up in this as we surprisingly recall the words and sing along to these songs!

Specifically, when examining TikTok, we can infer that the app allows individuals to feel understood through offering various personalised content and providing opportunities to be involved in the online community through encouraging individuals to take part in various trends, again echoing the community spirit felt previously when engaging in the trends of the 1930's dance halls.

If history has shown us anything, it is that people persevere through difficult times by building a sense of community. Through *Pandemic Objects: TikTok,* Reed has explored how this online platform of TikTok in the twenty-first century and the novelty dance, 'The Lambeth Walk', of the 1930s and 40s both promote positivity, and how TikTok has become a significant and meaningful part of our society – globally uniting us together while we combat this pandemic.

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Guest House For Young Widows – Among the Women of ISIS

Azadeh Moaveni (2019), *Guest House For Young Widows – Among the Women of ISIS*,
Melbourne: Scribe Publications,
352pp, ISBN: 9781526607423 (hardback)
338pp, ISBN: 9781925849608 (paperback)

Helen Stenger, Monash University, Australia

Guest House for Young Widows follows 13 women on their pathway in and out of ISIS. Azadeh Moaveni illuminates the women's stories by providing insights into their biographies and personal background, shedding light on their thoughts and feelings, while simultaneously putting their experiences into a local and international political context.

The book is structured into 5 main parts with 40 chapters as well as a prologue and an epilogue. At the beginning of the book, the grievances and struggles of the women living in Tunisia, Syria, Germany and London are described. Moaveni follows the lives of urban women from a variety of backgrounds: some are still in school, some have university degrees; some are young teenagers while others are middle-aged; some are secular, others are religious. Narrating the upbringing and experiences of the women places them in a wider context. For example, she describes what it was like to be a young woman in the Salafi movement in the aftermath of the Tunisian uprising, a university student from a modern household in Damascus, and how being a Muslim convert from a working-class background in Frankfurt influenced a young woman's life choices. By portraying these vastly different pathways to joining ISIS, the author showcases the diversity of the female recruit's motivations.

Moaveni illustrates how the women reached their individual decisions to join ISIS. While we may denounce the pathway they chose, this illustration allows us to understand their agency and humanity. She also provides details about the women's travel into ISIS-held territory in Syria and Libya – the 'caliphate'. Once the narrative is inside the 'caliphate',

Moaveni explores the different roles the women took on, which ranged from working for the moral police to becoming a housewife waiting for the husband to return from the battlefield.

She introduces the 'guesthouse' for widows – which is a place where all single and widowed women are staying – and outlines the pressure on the women to remarry. Within this context, Moaveni also explains the colonial and racialised hierarchies within ISIS, among both foreign fighters and the local population. The latter group often viewed foreigners 'as colonizers' (p. 187). Towards the final chapters, Moaveni examines how the women – to varying degrees – became increasingly critical of the organisation over time and how some of the women fled or tried to flee ISIS-held territory.

Throughout the book, Moaveni stresses the roles of Western colonialism, the War on Terror and Islamophobia, and how they fuel extremism. Western counter-terrorism measures are critically scrutinised since they typically fail to engage with these wider structural factors. The Islamophobic narrative and reluctance to understand the specific experiences of Muslim women in a Western context are particularly illustrated in the author's retelling of the Bethnal Green Girls' story – where four teenagers joined ISIS from Bethnal Green, London. The failure of counter-terrorism measures to engage with the grievances of young women drawn to ISIS is also demonstrated in Moaveni's examination of Tunisia, where discriminatory practices in prisons leave vulnerable women radicalised.

Guest House for Young Widows is a notable contribution to current debates surrounding women's involvement in terrorism, highlighting an intersectional perspective that considers gender, class, race, religion, age and ethnicity. Moaveni used primary and secondary data to write this book, including academic literature, policy documents, media articles and interviews. For this, she travelled to Tunisia, Syria, Turkey and the UK to gain a deeper understanding of the women's pathways. A methodological strength of the book is that Moaveni reflects on her own positionality during the investigative research. She discusses how her identity markers allowed her to blend in physically as well as how having religious literacy helped her with the research. Moreover, she explains that she felt close to some of her interviewees at times, saying that she 'could hear her adolescence' (p. 334). This approach – to reflect upon one's own identity, positionality and their power dynamics – is not only honest and brave but unique within terrorism literature.

In conclusion, the book achieves its goal of encouraging the reader to 'understand' why some women joined ISIS. It makes 'terrorism' both personal and tangible, even relatable, without justifying the women's choices. In this balancing act, Moaveni shows how it is possible to be a collaborator in terrorism and a victim at the same time. I recommend *Guest House for Young Widows* to policymakers, scholars and practitioners as well as everyone who is curious about why women from all over the world have been drawn to a misogynist terrorist organisation such as ISIS.

Alicja Lysik, Monash University

The insightful report that originated from *The New York Times* takes the reader on a gripping journey through Tunisia, England and France, among other places, showcasing the stories of 13 women, who for various reasons have left their homes to join ISIS in Syria. The book by Azadeh Moaveni is divided into five parts, where each part represents a different stage in the respective subjects' life. As a result, step by step, we have the opportunity to meet the young women, their family and friends, as well as glimpse into the environment surrounding them.

Azadeh Moaveni at no point of this book imposes compassion on the reader, which I personally found to be one of its biggest assets. The inquisitive reporting provides an opportunity to form your own opinion, based on the real-life stories of the young women, and on the prepossessed knowledge on the topic. Moaveni seems to be filling a gap as she injects a much-needed perspective in the sea of sensation-seeking publications. The journey that the reader experiences by diving into this story gives space to understand the background of the women's decisions, rather than merely to judge them as 'female jihadists' – a term most often used in the Western media. I also found it very compelling that Moaveni explicitly notes that many of the stories told by the subjects could be an attempt to portray themselves in a certain way (p. 332). One could argue, most likely justifiably, that this affects the credibility of the book. However, I believe that this is a given when it comes to interview-based reports.

Guest House for Young Widows eloquently shows that there is simply no single reason that prompted these women and young girls to make the decision to join the Islamic State. The reader follows how their initially different lifestyles start blending into seemingly the same story – of a woman who marries an ISIS fighter; he dies and becomes

a martyr; she then becomes a young widow, often to marry another fighter and eventually become a widow again. The strength of this book is also rooted in the variety of backgrounds that the female protagonists come from – some being fresh Islam converts like Dunya from Frankfurt, while some coming from traditional yet non-conservative families like Ghoufran and Nour from Tunisia. Sadly, the only voices that seem to be lacking from the story are those of hard-line female adherents of jihad, although this might be dictated, as the author mentions, by lack of the possibility to have a fully honest conversation inside the camps where most of the interviews had taken place (pp. 333–35).

In a very convincing way, Moaveni intertwines feelings and subjective observations with a factual political background, academic commentary and the socio-economic situation of the respective places. Throughout, the author draws on historical events of the region such as the Arab Spring, War on Terror or political struggles in Tunisia. All of the information combined gives the reader a well-rounded foundation to be able to fully understand the wider context and its implications. At the same time, the recurring theme of the Internet and social media reminds us of the contemporary nature of the stories. Understandably, this is an important thread as a lot of recruiting – especially in Western countries – happens through platforms such as Tumblr, Twitter, Facebook and WhatsApp. The author aptly describes this process when talking about one of the book's subjects: 'Sharmeena stumbled across, or was pushed into, a whole new world online' (p. 109). A world where she read about atrocities committed towards Muslims, about the need for the emergence of the caliphate and about the misunderstanding of Islam by many politicians and news outlets. However, what I found most striking was that there was a lot of exchange between women, young *muhajirats* (female migrants), who gave their diary-like testaments about life in the caliphate, which for many women was a final push to travel to Syria (for example pp. 110–13). The book also analyses how social media was utilised by the police – for instance, old Facebook posts being used during investigations (p. 289). Throughout all of the stories, social media seems to be always somewhere in the background – whether it is communicating with husbands on the battlefield, arranging the travel to – or an escape from –Syria, to watching YouTube videos of famous Arabic pop stars.

Finally, the amount of information the reader receives comes with certain strings attached; namely, it is sometimes difficult to follow all of the threads as you come back

to the same character after several dozen pages. This may, at times, make the story come across as disjointed, but this is a rather minor issue when you carefully follow the plot (or shall I say 'plots'?).

Guest House for Young Widows is a carefully crafted account based on years of reporting; countless hours of conversations, researching historical backgrounds and reaching out to many people who often responded with silence. The book is a must-read for those who already have an opinion on the topic, and those who are yet to form one.

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Reflections of *Reinvention* in Postgraduate Study

Peter Halat, Monash University and The University of Warwick

Two years ago, I wrote about how *Reinvention* itself exposes readers to an interdisciplinary toolbox of research methods (Halat, 2018). Since that time, the journal has continued to produce strong issues under the leadership of Hannah Duffus and Polina Zelmanova, and I myself have made the transition from undergraduate studies into postgraduate research studies.

As I enter the second year of my joint PhD between Monash University and The University of Warwick, I've noted the increasing and persistent pressure that comes with the candidature. For instance, there is a constant need to read and dissect new literature, but to also work on attaining new results. Modern mindfulness studies dictate against trying to complete both tasks at once, but to instead focus solely on one task at a time (Leroy, 2009). Throughout my two-year tenure at *Reinvention,* I developed an ability to swiftly read and assess undergraduate submissions to the journal, something that has proven to help me in my candidature, as I am confident in transferring the same critical approach to both postgraduate journal articles and my own writing.

I was invited to take part in an alumni panel at this year's edition of the International Conference of Undergraduate Research (ICUR, http://www.icurportal.com/), where I also reflected on the premise of presenting and watching undergraduate research. There are parallels in the benefits of participating in ICUR and *Reinvention*. To speak more generally about the interdisciplinary toolbox of research methods that *Reinvention* provides, it is worth noting that, in every issue of the journal, there are numerous examples of successful written research from a variety of disciplines. There are some seemingly intangible criteria that determine the value of a research project, and I contend that one of the best ways to begin to create a recipe for successful research is to immerse oneself in a research environment as soon as possible. Every issue of *Reinvention* is a prime opportunity for undergraduate students to see valuable research, and start to understand their hallmarks.

As Polina Zelmanova eloquently describes in her previous editorial, many of us are pondering on the past as well as the future in these uncertain times (Zelmanova, 2020). I

am no different, and as I wonder when I will be able to safely make the trip from Australia to the UK, I also have to consider how I might need to adapt my project for any scenario. As a theoretician, I am fortunate to be able to conduct productive work from home, which I have been doing for the past six months. In this time, I have been discussing with my supervisors from Monash and Warwick in the exact same fashion: over Zoom. Many people, myself included, were caught off guard by the severity of the pandemic, but also by the meteoric rise of the popularity of online teleconferencing software. Coincidentally, Zoom was the primary teleconferencing software the international *Reinvention* team used during my tenure, giving me prior experience to standard etiquette of international online teleconferencing, which is not as straightforward as it might seem.

Reflecting on my experience with *Reinvention,* it was nothing short of an informative and productive journey, which I am confident has helped me in the long term. I thank *Reinvention*'s current Editor, Polina Zelmanova, for inviting me to write this article. It is great to see *Reinvention* continue its success on a new platform, and to remain as innovative as it always has been. Finally, I would like to wish you, the reader, a safe and healthy future.

References

Halat, P. (2018), '*Reinvention*: An Interdisciplinary Research Toolbox', *Reinvention: An International Journal of Undergraduate Research,* 11 (2), available at https://warwick.ac.uk/fac/cross_fac/iatl/reinvention/archive/volume11issue2/editorial/, accessed 5 October 2020

Leroy, S. (2009), 'Why is it so hard to do my work? The challenge of attention residue when switching between work tasks', *Organization Behaviour and Human Decision Processes,* 109, 2, 168–181.

Zelmanova, P. (2020), '*Reinvention*: Building a future from our past', *Reinvention: An International Journal of Undergraduate Research,* 13 (1), available at https://reinventionjournal.org/index.php/reinvention/article/view/631, accessed 5 October 2020.

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