RESEARCH ARTICLE

The HCT Index: a typology and index of health conspiracy theories with examples of use [version 1; peer review: 1 approved with reservations, 1 not approved]

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Abstract

Background: Conspiracy theories regarding vaccination programmes, medical side effects, and cover-ups by governments or pharmaceutical companies are prevalent in many countries and have highly detrimental and far-reaching effects on people's wellbeing. For research and policymaking in public health, it is vital to understand the nature, construction and dissemination of these health conspiracy theories (HCTs). Inspired by tale typologies developed in folkloristics, this paper presents a typology and index of international HCTs as a tool for researchers to identify and categorise the HCTs they come across, and to provide a pool of examples of HCTs which could be used in various fields of research. To illustrate this, two studies are also presented (Study 1 and Study 2).

Methods: HCTs were collected from relevant academic literature, news journalism, a survey of known health-related, general conspiracy theorist websites, and web searches based around known HCTs. From this, 14 core types were identified, and a numbered index was constructed with brief descriptions, examples, and motifs. Study 1 is a survey of HCT exposure and belief in the UK. Study 2 is a focus group discussion of health rumours in rural Sri Lanka including discussion of HCTs.

Results: The HCT Index provides valuable insights into the international dissemination of HCTs. Study 1 found that familiarity with and belief in HCTs were high: 97% of Britons are familiar with at least one HCT and 49% of Britons believed that at least one HCT was likely to be true. Study 2 highlighted concerns over threats to fertility and about how to verify information that falls outside of typical experience.

Conclusions: The HCT Index provides a useful framework for future
cross-cultural research. As a typology it encompasses a wide range of beliefs which can be more effectively categorized and compared and, ultimately, challenged.

**Keywords**
Misinformation, conspiracy theory
Introduction
The dissemination of misinformation, such as “Fake News” or conspiracy theories, is a serious global issue in contemporary culture. The coronavirus disease 2019 (COVID-19) pandemic has highlighted the role of conspiracy theories in people’s response to disease outbreaks (van Bavel et al., 2020). However, this response is not novel. Conspiracy theories surrounded both the 2015–2016 Zika virus epidemic (Kadri & Trapp-Petty, 2016; Kloflstad et al., 2019) and 2013–2016 Ebola virus epidemic (Abramowitz et al., 2017; Collart et al., 2017; Falade & Coultais, 2017). Before the modern period the Bubonic plague and other disease epidemics were blamed on conspiracies involving Jewish people and people with leprosy (Alcabes, 2009; Brotherton, 2015). It has been argued that throughout recorded history conspiracy theories have been a common response to crisis situations, such as disease epidemics (Van Prooijen & Douglas, 2017).

Conspiracy theories can have particularly dire consequences when related to health. In South Africa in the 1990s, for example, misguided claims about the origins and best treatments for HIV/AIDS led to the premature deaths of an estimated 330,000 people (Nattrass, 2012). More recently vaccine refusal in Europe led to record high rates of measles cases in 2018 (WHO, 2018), with high profile medical professionals warning the public against misinformation disseminated on social media (Roxby, 2018). As well as secret agendas behind vaccination programmes, conspiracy theories concerning the side effects of medical treatments, and cover-ups by the government or pharmaceutical industry, are prevalent in many countries and can have highly detrimental and far-reaching effects on people’s wellbeing. Attitudes towards vaccines, rather than physical access issues, have become the primary barrier to vaccination (CDC, 2013). Research demonstrates that belief in health conspiracy theories (HCTs) is linked to reduced contraceptive use (Bogart & Thorburn, 2005), reduced intention to vaccinate (Jolley & Douglas, 2014), avoidance of mainstream medicine (Oliver & Wood, 2014) and is a significant obstacle to constructive public responses to pandemics (Van Bavel et al., 2020). For research and policy-making in public health, it is therefore vital to understand the nature, construction and dissemination of HCTs. A key tool in this endeavour is a typology of HCTs to enable researchers to identify and categorise the HCTs they come across, and to provide an international pool of examples of HCTs which could be used in various fields of research.

HCTs can be considered, alongside other urban legends and other kinds of conspiracy theories, as a form of contemporary folklore. These are distinguished from more traditional folklore, such as fairy tales, by their contemporary or post-industrial setting, but nonetheless resemble traditional folklore in many respects: The authorship of HCTs is anonymous and distributable, rather than attributable to a named individual. As with folktales, myths or legends, there is no single correct or authoritative version of an HCT, but usually multiple variants in circulation simultaneously. Specific actors, objects or episodes may be substituted, but the basic structure of the plot remains recognisably the same. Folklorists have developed a rich typological system for organising and classifying traditional narratives known as the Aarne Thompson Uther (ATU) Index of International Tale Types (Uther, 2004). The ATU Index groups related stories into numbered “tale types” based on broadly common plot features and “motifs” (specific episodes, characters or objects) that are sufficiently stable in their transmission that they can be used to link different versions of the story across widely separate times and places. The tale type index has played a critical role in comparative folkloristics, as captured in one prominent researcher’s comment that the ATU Index, together with the related Thompson Motif Index represent “the most valuable tools in the professional folklorist’s arsenal of aids for analysis” (Dundes, 1997).

Similar efforts to develop tale type systems have been developed for other narrative genres, such as ‘Shaggy dog stories’ and urban legends (e.g. Brunvand, 1963; Brunvand, 1993). In this paper, we extend the approach to health conspiracy theories. The intention is for this index to facilitate comparative studies of these narratives just as the ATU system has been used in traditional folklore research.

The primary purpose for collecting, organising, and classifying HCTs in an index is to provide a tool for future research. To our knowledge no such exercise has been previously undertaken. A recent study by Chan and colleagues (2021) examining the links between COVID-19 conspiracy theories and disease-preventative behaviours found that the influence varied by type of conspiracy believed, with some types linked to more engagement with preventative behaviours. This suggests that a typology of HCTs is a valuable resource, as different types may be predictive of different health behaviours. Additionally, a key aspect of this is the identification and typologising of specific HCTs to allow for cross-cultural comparison or simply aid in the description of how the HCTs are disseminated. The HCT Index can also be used as a source of examples for qualitative and quantitative research. To illustrate this, we provide details of two pilot studies conducted by the authors using content from the HCT Index.

Study 1. Exposure to and belief in health-related conspiracy theories in the UK
Research in the United States has found HCTs to be widely known, broadly endorsed and predictive of health behaviours (Oliver & Wood, 2014). Given the potential consequences of belief in HCTs on health behaviours (Bogart & Thorburn, 2005; Bogart et al., 2010; Jolley & Douglas, 2014; Oliver & Wood, 2014) it is important to assess the degree to which the general public in other countries are exposed to and endorse these beliefs. This research thus examines the extent to which people in the UK are exposed to and believe in a wide range of health-related conspiracy theories. The objective of this study is to determine how widely recognised HCTs are in the UK, to what extent they are believed, and to examine key demographic
influences on both recognition and belief. We make no specific hypotheses as to which HCTs are likely to be recognised or believed, or demographic effects.

Study 2. Focus group on HCTs in rural Sri Lanka

In Sri Lanka, a long history of political commitment to investment in health has led to the development of an extremely high-quality national health system in terms of both in- and outpatient care, and excellent performance on population indicators. It has become an example worthy of emulation across the developing world (e.g. Das Gupta et al., 2013; Samaratunge & Nyland, 2006). In terms of organisational and fiscal efficiencies, the Sri Lankan national health service (NHS) is said to outperform the local private health sector and national health systems of other countries of similar socioeconomic development (Hsiao & Li, 2000). However, as in other countries HCTs can threaten people’s trust in health interventions and generate concerns about health in general. While theories regarding the activities of unknown ‘others’ – Tamils, Muslims, evangelicals, the Indian secret service, the CIA, multinational corporations – are widespread in mainstream (Sinhala Buddhist) Sri Lankan society (Seneviratne, 1999), they do not exist self-consciously as ‘conspiracy theories’ as such (in the sense that those who believe them do not call themselves ‘conspiracy theorists’ but rather, perhaps, ‘nationalists’). Crucially therefore, this pilot allowed us to explore the extent to which the concept of ‘conspiracy theory’ itself exists in Sri Lankan culture, with a focus on HCTs. As part of an investigation into HCT concepts and attitudes we conducted a focus group in which medical interventions, the conspiracy theories related to these and other related issues were discussed.

Methods

HCT Index construction

HCTs were collected primarily from three sources: peer reviewed academic literature about conspiracy theories, news and magazine journalism and conspiracy theorist websites. Initial collection was from academic literature and news journalism identified in a preparatory scoping exercise (June–July 2014) performed as part of the activities of the Wolfson Research Institute for Health and Wellbeing’s Conspiracy Theories in Health Special Interest Group at Durham University.

A search for sources for HCT collection was conducted July to October 2016. Initially peer-reviewed academic sources were searched. We ran a database search of Web of Science, PsycINFO and Google Scholar databases for articles on conspiracy theories which included examples of HCTs. Our search strategy included the terms ‘conspiracy’ and ‘theor*’ with ‘medic*’ or ‘health’. As the purpose of this search was to find examples of HCTs we were agnostic towards research approach and/or scope. Only examples of specific HCTs were taken. For example, the survey used in Oliver & Wood (2014) contains the HCT “The Food and Drug Administration is deliberately preventing the public from getting natural cures for cancer and other diseases because of pressure from drug companies”, this would be considered eligible for collection (see criteria below). Where available, additional relevant information, such as location of belief was also collected.

As academic literature may not accurately reflect the extent of HCTs within wider society it was also considered necessary to search non-academic sources including conspiracy theorist sources and journalism. A survey of known health-related or general and health-related conspiracy theorist websites, such as naturalnews.com, and books, such as David Icke’s The Biggest Secret: The Book that will Change the World was conducted. In addition, we conducted web searches based around known HCTs. As conspiracy theorists may not describe themselves or their theories as such, in addition to the terms used form the academic literature search, this search was conducted using search terms based on known HCTs and medical controversies. Google was searched using terms shown in Table 1.

Following this search of non-academic sources, a second search of academic literature was conducted using the same terms.

A full list of sources is presented in SM.1 in the extended data (Stubbersfield et al., 2021). HCTs were added to the index only if they met at least one of the following eligibility criteria for inclusion as an HCT, viz. a belief that either a group of individuals or an organisation is deliberately and secretly:

- a) causing harm to the health of the general public or a specific group within it,
- b) covering up evidence of causes of harm to the health of the general public or a specific group within it,

Table 1. Search terms used to search for examples of health-related conspiracy theories (HCTs).

<table>
<thead>
<tr>
<th>Topic/Controversy</th>
<th>Additional terms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anti-vax/Anti-vacc*/Antivax/Antivacc*</td>
<td>Cover up</td>
</tr>
<tr>
<td>MMR</td>
<td>Conspiracy</td>
</tr>
<tr>
<td>Zika</td>
<td>Hoax</td>
</tr>
<tr>
<td>Chemtrail/Chem-trail</td>
<td></td>
</tr>
<tr>
<td>Cancer cure</td>
<td></td>
</tr>
<tr>
<td>AIDS</td>
<td></td>
</tr>
<tr>
<td>HIV</td>
<td></td>
</tr>
<tr>
<td>Fluorid*</td>
<td></td>
</tr>
<tr>
<td>Big Pharma</td>
<td></td>
</tr>
<tr>
<td>Mobile/Cell Phones</td>
<td></td>
</tr>
<tr>
<td>Ebola</td>
<td></td>
</tr>
<tr>
<td>GM/Genetic Modification</td>
<td></td>
</tr>
</tbody>
</table>

Table 1. Search terms used to search for examples of health-related conspiracy theories (HCTs).
c) not acting on evidence of causes of harm to the health of the general public or a specific group within it,

d) opposing treatments which benefit health (not necessarily secretly in this case, although their true motivations for doing so would be secret), and

e) using public health interventions as a cover for other activities.

Early in the process it was decided to classify the HCTs by subject or plot (i.e. “anti-vaccination”) rather than the effect (i.e. “sterilisation”). While both are equally valid approaches it was decided to classify by subject due to it being easier to find HCTs online by subject rather than by effect. Data saturation was considered when searching produced HCTs which did not necessitate the creation of novel HCT types in the index.

Through the index fourteen key HCTs were identified, with several having multiple sub-categories. The core 14 were:

1. Disease Origin
2. Illegal Drug Use Promotion
3. Food Contamination
4. Experimentation without Consent
5. Anti-Vaccine
6. Family Planning Campaigns
7. Genetically Modified Organisms (GMOs)
8. Chemtrails
9. Water Contamination
10. Disease Research Scam
11. Pesticide Cover for Poisons
12. Information Suppression
13. Medical Science is Corrupt
14. Faked Disease Pandemics

Each one is numbered, features a brief description and examples, with the example source and country of origin identified. Motifs are listed in square brackets. The term ‘they’ is occasionally used in the HCT descriptions as a proxy for the various governments, organisations, agents etc. thought to be behind the conspiracy. These may vary from version to version as in the following example:

001 Disease Origin

*Disease was created rather than emerged ’naturally’*

Examples:

1. HIV is a genetically modified organism developed by U.S. Government scientists. **USA. Cantwell (1988); Cantwell (1993).**

Sub-categories are also listed with examples. See example below:

003 Food Contamination

003-1 Sterilising Chemicals

*Food is being deliberately contaminated with sterilising chemicals*

Examples:

1. Companies associated with the KKK are contaminating fried chicken with sterilising chemicals to target the African American community. **USA. Turner (1993). [Fertility] [Outgroup Threat]**

The indexing also identified five key motifs which frequently appeared across the examples. These are:

1. (Threats to) Fertility
2. Outgroup Threat
3. Female Victim
4. Child Victim
5. Minority Victim

If an example includes another HCT type this is referenced in square brackets after the type is mentioned. For example, Example 4 of type 004-2, ‘Human Guinea Pigs’, is:

‘The US government pay the pharmaceutical company Merck to produce lethal cocktails of drugs and vaccines [005] and test those on the general public.’

The ‘[005]’ indicates that this example also features HCT type 005, ‘Anti-Vaccine’. See SM.2 for the synopsis and full HCT Index (extended data, Stubbersfield et al., 2021).

After construction of the HCT Index another search was conducted (September 2016) to assess data saturation of the HCT types and to add new examples. We then made the HCT Index publicly available as a preprint (Stubbersfield et al., 2019) and periodically revised and updated it during that period. Another search was conducted in September 2020 in response to the COVID-19 pandemic and associated conspiracy theories. This used the terms COVID, Corona virus, SARS-CoV-2 and conspire*, hoax or cover-up.

Study 1. Exposure to and belief in health-related conspiracy theories in the UK

**Participant recruitment.** Participants were recruited online through the Prolific participant recruitment platform (www.prolific.co) and completed the survey in March 2017 and were rewarded £1.00 for their participation. Participants had to be UK residents aged 18 or over to take part. Survey results were weighted by age, gender, race/ethnicity, highest qualification and UK region of residence based on data from the 2011 UK Census (Office for National Statistics, 2016) to provide a representative sample of the UK population. A sample size minimum of 500 participants was intended, for a
margin of error of <5 at a 95% confidence level, which was deemed an acceptable margin for the objectives of this study.

**Procedure and materials.** After providing their consent and demographic information, participants were presented with 15 health-related conspiracy theories (HCTs). Six of these were sourced from Oliver & Wood (2014) for the purpose of comparison but with US-specific details altered and language localised to the UK. The remaining nine were sourced from the HCT Index. Participants were asked whether they had heard of the HCT or something similar before or had never heard it. If they had heard of it (or something similar), they were asked if they remembered where they had heard it and, if so, where that was. They were also asked to rate the extent to which they agreed with the statement that the presented HCT was “likely to be true” on a Likert scale ranging from 0 (strongly disagree) to 6 (strongly agree). The presentation order of HCTs was randomised to avoid order effects (see SM.3 in the extended data for details of survey content, Stubbersfield et al., 2021). The questionnaire used is a novel questionnaire and has not been previously validated.

**Ethical approval.** Ethical approval was provided by the Anthropology Department Ethics and Data Protection Subcommittee, University of Durham, UK (01/03/2017).

**Analysis.** Associations between variables were tested using Spearman’s rank correlation coefficient. Comparisons between groups were conducted using Kruskal-Wallis analysis of variance. All statistical analyses were conducted using IBM SPSS Statistics for Windows, Version 24.0. The same analysis can be conducted using GNU PSPP, an open access alternative to SPSS, or using the open access programming language R (available here: https://cran.r-project.org/).

**Study 2. Focus group on HCTs in rural Sri Lanka**

**Design.** We conducted a focus group interview (duration: sixty minutes) to explore topics related to medical and health-related rumours, their social transmission, and the participants’ attitudes towards them.

**Participants and setting.** The research took place in a village in the north-central province of Sri Lanka consisting of 130 households of Sinhala paddy farmers and their families in May 2017. Participants were recruited through opportunity sampling and were approached face-to-face. Individuals who were resident in the village and were over the age of 18 years were considered eligible. We aimed to recruit between five and eight participants based on prior experience of suitable focus group sizes and recommendations from existing literature (e.g. Krueger & Casey, 2015). Due to time limitations, we did not expect to achieve data saturation with this focus group.

**Researcher characteristics.** The focus group interview was conducted by JMS and TW, with the assistance of a research assistant (RA), who also acted as a translator (primarily for JMS). All are male. JMS and TW are white British, and the RA is Sinhala Sri Lankan. JMS holds a PhD in Anthropology and Psychology and was employed as a post-doctoral research associate at the time of the study. TW holds a PhD in Anthropology and was employed as an associate professor at the time of the study. Both researchers are experienced researchers trained in qualitative research methods and TW, at the time of the study, had ten years of experience of qualitative research methods in Sri Lanka, including focus group interviews.

TW has conducted ethnographic research in this village since November 2015, with a central focus on the health problems associated with agrochemicals and the HCTs surrounding them, the same RA was also involved in that research. At the time of the focus group, all researchers had been present in the village for several days. Based on this prior experience and research researchers assumed that a key concern would be chronic kidney disease of unknown origin (CKDu), and related concerns including agrochemicals. Additionally, based on prior work on HCTs including construction of the HCT Index, researchers assumed that the Sri Lankan participants may share similarities with other groups in South Asia, and that HCTs associated with threats to fertility would be common.

**Procedure.** The focus group took place outside the home (porch) of one of the village residents. No one was present other than the focus group and researchers. All participants in the focus group were provided with an information sheet about the nature of the study and were required to sign a consent form. The information sheet included details of funding, aims and objectives, broad topics for discussion and information about their anonymity in any subsequent publication. All information provided to participants was in Sinhala. Participants took part in open discussion on the topic of medical and health-related rumours and their attitudes towards them. Topics for discussion were based on the transmission of HCTs and contemporaneous fieldwork in the locale (see SM.5 in the extended data for topic guide, Stubbersfield et al., 2021). The topic guide was not piloted and had not been used previously. The focus group was audio recorded and no field notes were made. Audio recordings were professionally translated and transcribed into English (full transcript translated into English is available as underlying data). Transcripts have not been returned to participants for comment. No repeat interviews or focus groups were conducted.

**Ethical approval.** Ethical approval was provided by the Anthropology Department Ethics and Data Protection Subcommittee, University of Durham, UK (10/11/2016) and the Ethics Review Committee for Social Sciences and Humanities, University of Colombo, Sri Lanka (15/03/2017. Ref: ERCSSH/17/35).

**Analysis.** Coding was conducted by JMS using an explanatory thematic analysis. This analysis was content-driven, and themes were derived from the data. Themes derived from the data were compared to motifs from the HCT Index and individual HCTs discussed by participants were identified by HCT Index type. No software was used.
Results and discussion

Study 1. Exposure to and belief in health-related conspiracy theories in the UK

Sample details. In total, 521 adults living in the UK participated (Stubbersfield et al., 2021). Seven participants were excluded due to not completing the survey, leaving a total 514 adults who completed the online survey and were included in the study analyses. The final sample comprised of 301 women and 211 men who ranged in age from 18 to 74 years (mean = 37.13, sd = 12.51). The sample size gives a margin of error of 4.42 at a 95% confidence level, which was deemed an acceptable margin for the objectives of this study.

Most recognised and believed HCTs. HCTs about vaccinations causing autism (HCT 005-4), the suppression of natural cures for cancer (HCT 012-1) and mobile phones causing cancer (HCT 012-2) were familiar (heard before or heard similar) to at least half the sample. These three HCTs were also the three most believed to be likely to be true (see Figure 1).

Other HCTs included iodine in table salt being used to limit population growth (HCT 003-1), the United Nations International Children’s Emergency Fund (UNICEF) using vaccines as a cover for chemical contraceptive experiments (HCT 005-1-1), genetically modified (GM) foods being used as part of plot to shrink the global population (007-2), fluoridation of water being a method to dispose of chemical waste (009-2-4-1), and the efficacy of the human papilloma virus (HPV) vaccine in males (005-3). These were less well recognised, with less than 25% of the sample having heard the same or similar before. This could be expected given that some were focused on threats to fertility, which appear to be less common in developed countries based on examination of the HCT Index. Three of these were also among those rated as most likely to be false (i.e. received scores 0–2): 85.9% disagreed with the proposition that iodine salt was being used to limit population growth; 81.7% disagreed with the idea that water fluoridation was chemical waste; 85% disagreed that UNICEF was using vaccines for contraceptive experiments. Finally, HCTs about vaccines being used to implant tracking microchips in people (HCT 005-5), and water fluoridation being used to reduce resistance to control (HCT 009-2-1) were among those least believed to be true, being disagreed with by 92% and 87% of the sample respectively. According to our study, 97% of Britons sampled were familiar with at least one HCT (meaning they had heard the same or similar before) while 78% were familiar with three or more. Forty nine percent of Britons believed that at least one HCT was likely to be true, while 24% believed that three or more were likely to be true. SM.4 in the extended data has a table listing the proportions of Britons who reported having heard the same or a similar HCT to the 15 presented, the most common source of hearing about it and the extent to which they believed it was likely to be true (Stubbersfield et al., 2021).

Comparison with the USA. The results of this UK-based survey are very similar to those of a US sample studied by Oliver & Wood (2014). The same proportion of both samples agreed with at least one HCT (49%), while the number who agreed with three or more was higher in the UK sample (although those in the UK sample were presented with more options). Generally speaking, the UK sample was both more likely to believe an HCT was true, and to believe it was false, than their counterparts in Oliver and Wood (ibid.) because the undecided option was chosen more rarely by the UK group. This could suggest that Britons are firmer in their position on HCTs than Americans, whether in agreement or disagreement, however, it could also be an artefact of the study design (a 0–6 Likert scale rather than three options). In both samples the most familiar and most believed HCTs were about vaccinations causing autism, the suppression
of natural cures for cancer and that mobile phones caused cancer. In short, the results suggest that people in the UK and USA share similar attitudes with regards to HCTs. This is despite having different healthcare systems (primarily private sector in the USA and primarily public sector in the UK) and markedly different levels of trust in healthcare professionals: 76% of Britons believe doctors can be trusted compared to 58% of Americans (ISSP, 2013). A possible explanation for the shared attitudes is shared exposure to increasingly international forms of media, such as online social media and websites.

**Exposure to HCTs.** Table 2 reports the percentage of respondents who had heard an HCT before and could remember where they heard it. In total, 43% of respondents who were familiar with a HCT and could remember where they heard it reported hearing it from multiple sources. When a single source was reported, online media (websites, social media) accounted for the largest proportion: 46% stated they had heard the HCT from a non-news website, a news website, or social media. ‘Traditional’ media, such as television and newspapers, was cited as a source for less than 2% of the HCTs. Word of mouth was a sole source for 9% of HCTs.

Although people are familiar with more HCTs than they believe, there was a significant positive correlation between the numbers of HCTs a respondent was familiar with and the number they agreed were likely to be true (Spearman’s Rho, $r = .26, p < .001$). The direction of this effect is not something which can be determined from these data, as it may be that increased exposure to HCTs increases the chance that one will believe in their veracity; conversely believing in the truth of one HCT could lead one to seek out exposure to others, or both possibilities could be true and create a reinforcing cycle.

**Demographic effects**

**Age**

Three participants did not provide their age, leaving a sample of 511 for these analyses. There was significant variation between age groups in terms of familiarity with HCTs ($\chi^2_{6} = 15.35, p = .004$), with 35–44 year-olds being familiar with fewer HCTs on average than 18–34 year olds ($p = .01$) and, marginally, 55–64 year olds ($p = .046$). This difference in familiarity did not translate into a significant difference in mean number agreed with, however ($\chi^2_{6} = 6.23, p > .05$). No other significant differences in agreement or familiarity were found between age groups ($ps > .05$).

**Gender**

One participant did not provide their gender, leaving a sample of 513 for these analyses. There were no significant effects of gender on either familiarity ($\chi^2_{1} = 1.65, p > .05$) or agreement ($\chi^2_{1} = 1.84, p > .05$).

**Race/ethnicity**

Racial or ethnic group identification was self-reported using group labels derived from the broad categories used in the 2011 UK Census (Office for National Statistics, 2016) or open response. One participant did not provide the race/ethnicity, leaving a sample of 513 for these analyses. Differences between racial or ethnic groups were non-significant in terms of familiarity with HCTs ($\chi^2_{7} = 9.49, p = .05$). However, there were significant differences between groups in mean number of HCTs agreed with ($\chi^2_{7} = 39.96, p < .001$), with Asian/Asian British respondents agreeing with significantly more HCTs than White respondents ($p < .001$). No other significant differences in agreement or familiarity were found between racial or ethnic groups ($ps > .05$).

**Education level (highest qualification)**

All participants provided their education level. There was significant effect of education level on familiarity with HCTs ($\chi^2_{6} = 15.35, p < .001$). Those respondents with no formal qualifications were familiar with more HCTs on average than those respondents with secondary education (GCSE, O-levels or equivalents) as their highest education level ($p < .001$). These differences in familiarity did not translate into a significant difference in mean number agreed with, however ($\chi^2_{6} = 10.60, p > .05$). No other significant differences in agreement or familiarity were found between education levels ($ps > .05$).

**Political affiliation**

Data on political affiliation were taken from a screening survey provided by Prolific and completed by participants at some point prior to participation in this study. Data were available for 364 participants. There was a significant effect of political affiliation on familiarity with HCTs ($\chi^2_{6} = 16.44, p < .001$), with those respondents identifying as politically right being familiar with fewer HCTs on average than those respondents identifying as politically centre ($p = .006$) or left ($p < .001$). There was also a significant effect of political affiliation on the mean number of HCTs regarded as likely to be true. Those respondents identifying as politically left agreed with fewer HCTs on average than those respondents identifying as politically centre ($p < .005$) or right ($p < .001$).

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**Table 2. Sources for receiving health-related conspiracy theories (HCTs) and the percentage they were cited as a source of hearing about a HCT.**

<table>
<thead>
<tr>
<th>Source</th>
<th>Percent reported</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multiple sources</td>
<td>42.72</td>
</tr>
<tr>
<td>Website (not news or current affairs)</td>
<td>15.97</td>
</tr>
<tr>
<td>Online social media</td>
<td>15.73</td>
</tr>
<tr>
<td>News website</td>
<td>14.08</td>
</tr>
<tr>
<td>In person (known)</td>
<td>7.47</td>
</tr>
<tr>
<td>In person (stranger)</td>
<td>1.41</td>
</tr>
<tr>
<td>Newspaper</td>
<td>1.41</td>
</tr>
<tr>
<td>Other source</td>
<td>0.86</td>
</tr>
<tr>
<td>Television</td>
<td>0.37</td>
</tr>
</tbody>
</table>

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**Brexit voting decision**

Data on political affiliation were taken from a screening survey provided by Prolific and completed by participants at some point prior to participation in this study. Data were available for 413 participants. Five participants reported not being eligible to vote at the time of the referendum and were not included in the analyses, leaving a sample of 408 (with 30% voting leave, 62% voting remain, and 8% eligible but not voting). There was no significant effect of reported Brexit voting decision on familiarity with HCTs ($X^2 = 4.11, p > .05$). There was however an effect on the average number of HCTs believed as likely to be true ($X^2 = 49.05, p < .001$). Respondents who reported voting for the UK to leave the European Union agreeing with more HCTs on average than either respondents who reported voting to remain ($p < .001$) or those who reported being eligible to vote in the Brexit referendum but had chosen not to ($p < .001$).

**Discussion.** In general the results of the survey suggest that both familiarity with and belief in HCTs is relatively high among people in the UK, with almost all respondents being familiar with at least one HCT and half believing that at least one was likely to be true. The results are strikingly similar to those of a similar survey conducted in the USA where very similar levels of belief and in essence the same HCTs served as the most familiar and believed. A possible explanation for this similarity is increasingly shared media between the USA and UK, particularly online forms of media, as these were shown to be the most common source of learning about an HCT. This finding also suggests that belief in HCTs is apparently independent of several variables, such as the nature of healthcare provision, or post-colonial status. To what extent this would also be true of countries outside UK and USA should be the subject of further research. A recent global survey on vaccine confidence found significant cross-cultural variation in attitudes towards the efficacy and safety of vaccines (Larson et al., 2016). This may indicate a similar variation in belief in other HCTs may be found.

Despite familiarity with HCTs and agreement that they were likely to be true only correlated positively with one demographic category, political affiliation was found to affect both familiarity and belief, and this was not in the direction predicted by the correlation. Despite being familiar with fewer HCTs than people who identified as left wing or centre, respondents who identified as right wing believed that more HCTs were likely to be true. Other demographic measures which affected familiarity (age and education) did not influence belief, while other measures did not affect familiarity but were associated with belief (i.e. race/ethnicity, Brexit voting decision, attitude toward vaccination). The finding that British Asians were more likely to endorse HCTs echoes similar results found in ethnic minorities (African Americans and Latin Americans) in the USA (see Ross et al., 2006) and could be influenced by similar experiences of racism and a generalised mistrust in state institutions or, in the case of pharmaceutical companies, global corporations.

However, such conclusions cannot be reached from the present data and further research would be needed to examine the socio-cultural determinants of increased belief in HCTs among British Asians. The perception of Brexit leave-voters as ‘anti-expert’ and ‘anti-globalist’ also sees support in them being more likely to endorse HCTs. But again, further research is needed to examine the factors involved.

That people were familiar with more HCTs than they believe demonstrates there is some form of selection occurring about which are believed. It is clearly not the case that some individuals simply believe whatever HCT they encounter. Future research should examine what makes some HCTs more likely to be believed than others, and how these traits may interact with individual variation in their believers.

That the level of familiarity and belief is so high in the UK could have serious implications for national health, as belief in HCTs has been shown to have effects on vaccination intentions (Jolley & Douglas, 2014), and more recently reduced intention to vaccinate against COVID-19 (Berin et al., 2020; Romer & Jamieson, 2020). Beyond vaccination, belief in HCTs has also been shown to have negative effects on adherence to antiretroviral treatment among people with HIV (Bogart et al., 2010), attitudes towards condom-use (Bogart & Thorburn, 2005), and general avoidance of mainstream medicine (Oliver & Wood, 2014). The finding that 25% agree that ‘the government continues to vaccinate children despite knowing that vaccines cause autism and other disorders’ is of particular concern, as herd immunity only exists when a high proportion of people in the population are vaccinated. For example, 19 out of every 20 people need to be vaccinated against measles to protect people who are not vaccinated. Current MMR vaccine coverage, however, is generally high but varies from region to region and is often below the 95% required for herd immunity. Further research is needed to examine the role of HCT beliefs in this deficiency.

While efforts were made to recruit a representative sample, the nature of online participant recruitment means that the sample will be inevitably biased towards UK residents who have access to the internet. However, the nature and direction of the impact of this bias on the results is unknown. Additionally, all results should be considered in the context of the margin of error related to the sample size. Sample size is a particular limitation for the results related to political affiliation and Brexit voting decision (which was also unrepresentative in terms of leave/remain split). As such these results should be viewed with caution and considered as indicative of potential trends warranting further research.

The period of survey participation (March 2017) represents a key limitation on the generalisability of results to contemporary UK society. Especially given the potential impact of COVID-19 beliefs on both exposure to and belief in wider HCTs. However, having data on HCT belief from this ‘pre-COVID’ period is of value. To our knowledge no equivalent data focusing on HCT belief in the UK is available.
and the results of this data suggest that HCT exposure and belief was high prior to the onset of COVID-19 pandemic, suggesting a vulnerability to these beliefs, especially in the context of a pandemic and introduction of a novel vaccine. It is interesting to note that the HCT Index types of the two most believed and recognised HCTs (012-1 - Cure suppression, and 012-2 - 012-2 - Evidence of harm suppression) were also reflected in widespread COVID-19 related beliefs surrounding hydroxychloroquine and 5G signal. Future research could use the HCT Index to examine belief in HCTs by ‘type’ as opposed to specific theories or general conspiracist attitude to gain insight into which types prove to be particularly popular and provide predictions about what types of HCTs may prove popular in future.

Study 2. Focus group on HCTs in rural Sri Lanka

Participant characteristics. In total, ten participants were invited to attend the focus group. Of these, six participants attended (three men and three women). No ages were recorded. All participants were residents of the village and were Sinhala Sri Lankan. Individuals who were invited to attend the focus group but did not were not asked to explain why they did not attend, and no reasons were provided.

Coding of transcript. The audio recording of the focus group was professionally transcribed and translated into English. JMS coded the focus group transcript. Two major themes were present in the focus group interview: HCTs featuring threats to fertility and Islamophobia; and concerns over challenges to trust (see SM.6 in the extended data for coding tree showing major themes and connected sub-themes, Stubbersfield et al., 2021). These are connected, in the sense that HCTs may succeed in environments with low trust in institutions and could also contribute to reduced trust, however, we cannot comment on the direction of their connection in this locale. Participants have not provided feedback on these findings.

HCTs featuring fertility threats and Islamophobia. During the focus group a number of HCTs were discussed. Concerns were expressed that Muslims were attempting to secretly sterilise the majority Sinhala population. Specific examples of these HCTs included a concern that rice provided as aid to the village by Pakistan would make people infertile (HCT 003-1) (“there were 50kg bags of rice given to the people as subsidies and the rumor says that certain germ has been injected to those rice bags that make people infertile” FPt_01) or that certain seat covers for motorcycles produced in Pakistan contain a toxic material which sterilises the rider “seat covers of bicycles introduced by Pakistan are also believed to contain such toxic materials too” MPt_02/03). The sterilising motorcycle seat covers belief has no direct correlate example in the HCT Index, it would come under HCT 003, Contamination, and most resembles HCT 003-1, but is a rare example of contamination of a non-food item. There was also an HCT being spread via social media at the time the researchers were present in the village which suggested that Islamic State (ISIS) members were posing as medical professionals, taking blood samples, and secretly injecting people with HIV. ISIS injecting people with HIV example similarly has no direct correlate in the HCT Index. It could be considered a variant of HCT 005-2, Disease Spread, but features the taking of blood samples rather than vaccination. Based on discussion within the focus group it is plausible that these concerns are, at least partly, based on observations of reduced fertility compared to the past, with people recognising that younger people are having fewer children than older generations (“the youth today do not have children compared to their elder generations” MPt_02/03). While this is caused by lifestyle changes as Sri Lanka experiences the demographic transition, and the demographic transition is understood by people in Sri Lanka, such social changes may also inspire or help propagate fertility related HCTs. These particular HCTs are also likely to be influenced by a perceived increase in the Sri Lankan Muslim population. Sri Lankan Muslims (or Muslim majority countries) are frequently identified as the alleged conspirators and it is suggested that these HCTs are part of a plot to reduce the Sinhala population and increase the Sri Lankan Muslim population (“It is believed that Muslims concern [sic] about spreading their race, so they work against Sinhalese” FPt_02). Both aspects represent concerns over changes in the cultural demographics of Sri Lanka.

Challenges to trust. Generally, individuals did not hold an absolute belief in the veracity of these HCTs but said they were “afraid” or “confused” by feeling unable to determine if the rumours they heard were true or false. They felt that the cultural systems in the village were not developed to deal with rumours originating outside the village and as such they could not determine their veracity, (“if it is within the village we can discuss and get over it. But since information such as ISIS interventions come through the media we are unable to solve those issues... Our village systems are not developed enough to cater such information” FPt_02). Participants suggested that the government should help determine whether health-related rumours were true. However, they also recognised that people would not necessarily believe statements from authorities due to alleged corruption and the potential for bribery (“we normally do not believe things at once, even it was told by the government sources. In Sri Lanka today, even DSs will also fabricate rumours if they were offered a bribe” MPt_02).

Individuals also gave several indications about how not only health information but also HCTs and health rumours were transmitted. They named several sources alternative to official sources for this kind of information, such as friends, family and the media, including online social media, but mentioned that they are often unsure of the original source of information (“We are not sure whether it comes from the city or from the village or from anywhere else”, FPt_02). They also stated that rumours were transmitted where villagers gathered together, such as the market or bathing places.

Minor themes. A minor theme that emerged from the focus group interview was success of negative information. It was
suggested that negative information was more likely to be transmitted than positive information (“There is a tendency, that the bad things spread easily than the good” MPt_02). With an exception to this being personal health information, as it was suggested that individuals were more likely to discuss the illnesses of others than of themselves (“many people tend to hide their illnesses, especially, kidney or diabetes failures. Unless to a family member they will probably tell that they are healthy. Because they think it is a shame… Normally they use to rumour about other’s illnesses but not their own” MPt_01).

**Discussion.** The focus group suggests key concerns among the Sinhala community in this locale. Key concerns, reflected in the HCTs, relate to perceived changes in the cultural demographics of Sri Lanka, specifically reduced fertility in young Sinhala and a growing Muslim population. In the HCTs, these concerns are connected into a narrative of Muslims conspiring in plots which threaten the fertility of Sinhala Sri Lankans. These HCTs typically resemble HCT 003-1 (contamination – sterilising chemicals), reflecting a widespread, global concerns about fertility. Unique variations were also found, and future research could examine how widespread some of these seemingly unique variations (contaminated bicycle seats and sanitary products) are both in Sri Lanka and elsewhere.

Given the sample of a single focus group, it is unlikely data saturation was achieved (based on guidance from Hennink *et al.*, 2019), therefore there are limits to generalisability. As such these results should be viewed with caution and considered as indicative of potential trends, nevertheless, the study serves the purpose of developing codes and suggesting points for further research both in the same locale and elsewhere.

**General discussion**

The HCT Index itself can provide several interesting insights into the international dissemination of HCTs. For example, from examining the motifs examples we can see that HCTs related to fertility are common (the Fertility Threat motif), largely involving secret attempts to sterilise a population through medical interventions, a concern which was expressed by participants in Study 2. A very common version is that vaccination programmes are being used to sterilise people. These sterilisation HCTs are almost exclusively found in developing nations, while Western nations seem to be more concerned with survival than sterilisation, with vaccinations considered as spreading diseases rather than sterilising. However, while threats of secret sterilisation seem to be largely absent in Western nations, HCTs with children as the victim are common (the Child Victim motif), perhaps reflecting similar concerns. Also, fertility-threat HCTs are found within minority communities in Western nations, primarily the African American community in the examples currently listed (Minority Victim motif). Beyond threats to fertility, by examining type 005, Anti-Vaccination, we see that vaccinations feature in a wide range of HCTs, with wide ranging motives and effects. These include spreading disease, covert genocide, and the implantation of tracking microchips.

This simple examination of types and motifs provides a number of potential avenues for future cross-cultural research into HCTs, and how certain types of content and threats are likely to be more successful than others in certain contexts. This could also give insights into how these attitudes could be countered. The two study examples illustrate the value of the index as a source of material for both quantitative and qualitative research. In both studies the HCT Index provided initial examples which could be adapted to different research paradigms and provide insightful results. Study 2 demonstrates how the typology can be used to categorise novel HCTs identified by participants through qualitative research. This then permits comparison with known HCTs existing elsewhere.

Currently, the HCT Index is a working document. It is open to further expansion of examples and refinement of types and motifs. A limitation of the current version is a focus on English language sources for the examples (and therefore the types). Non-Western examples are largely from secondary sources, such as anthropological research. The Index may thus not be generalizable to HCTs globally and may be more representative of HCT beliefs in the English-speaking West than elsewhere. This, however, is confounded by the issue mentioned in Study 2, namely that while beliefs meeting our defining criteria exist in many societies, they do not exist self-consciously as ‘conspiracy theories’ and hence can be more challenging to identify. Further, the number of motifs could be expanded by more detailed analysis of the current examples, and perhaps comparison with the ATU system motifs, since contemporary folklore often reflects motifs seen in traditional folklore. Despite these limitations, the HCT Index provides a useful framework for future cross-cultural research. The typology is likely to encompass a wide range of beliefs and allow these beliefs to be more effectively categorised, compared and, ultimately, challenged.

**Data availability**

**Underlying data**


This project contains the following underlying data:

- Focus Group Transcript.pdf
- Survey Data.csv
- Survey Data.xlsx

**Extended data**

Open Science Framework: The HCT Index: A Typology and Index of Health Conspiracy Theories with examples of use.
This project contains the following extended data:

- Stubberson et al., 2019 HCT Index.pdf
- Stubberson et al., 2019 HCT Index Appendices.pdf
- SM.1. List of sources for construction of HCT Index.pdf
- SM.2. HCT Index.pdf
- SM.3. Study 1 survey content.pdf

Data are available under the terms of the Creative Commons Attribution 4.0 International license (CC-BY 4.0).

Acknowledgements

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In this paper, the authors attempt to create a typology of health conspiracy theories (HCT) and examine it in the context of two studies: the first, a quantitative survey of HCT beliefs in the UK, and the second a study of health rumours in Sri Lanka. The fundamental premise of this study is of value to help organize the increasingly crowded body of literature around health misinformation, but the paper requires major revisions on account of several theoretical and methodological limitations.

1. At the outset, the authors offer the promising prospect of developing a typology that is “inspired by folkloristics”. They proceed to mention the ATU Index Groups, Shaggy Dog Stories and urban legends. However, it is unclear how the methodological and theoretical underpinnings that shaped these works have informed the development of the HCT index. Specifically, the methodological process involving a review of academic papers, news media articles and books seems rather ad-hoc instead of conceptually and methodologically rigorous and well thought out. Which, in turn, leads to multiple questions: 1) on what basis were the academic papers, news media articles and book chosen? 2) What steps were taken to ensure that this selection was thorough and complete, or to ensure that critical literature was not missed? 3) What was the time range for the literature search and why was this range defined for that time period?

2. In relation to the above point, the HCT index seemed like a simple mix of different kinds of HCTs that have been extracted in different literatures. It was not clear how the different elements of the index were bound together which was surprising given the wealth of available psychological and anthropological research on conspiracy theories. For instance, can one of the binding constructs be that of ‘blame attribution’ (e.g.) conspiracy theories that blame either migrants or the pharma industry or politicians?). I would recommend to the authors to extract one of the many relevant frameworks from the extant literature around HCT and organise the typology in more conceptually informative fashion. Lastly, COVID-19 has provided possibly the widest, and long-lasting canvas for HCTs to emanate and proliferate – it was unclear as to why the authors have not used the richness of COVID-19
misinformation to recalibrate the structure and contents of the typology.

3. The rationale for conducting the UK survey was found wanting. As in, it is unclear what the authors were attempting to accomplish through the survey. Were they planning to validate the typology? If so, the statistical process for typological validation was not clear; it needs to be described in detail, as does the process of analysing the findings (which at this stage are restricted to descriptive statistics).

4. Similarly, the rationale for including a second study with a single focus group conducted in Sri Lanka is simply not clear. Again, if the motivation was to validate the index using a qualitative study, a single focus group provides too weak a foundation on which to undertake such an endeavour. Also, the focus group description suggests that the focus of the session was “health rumours” – as such, health rumours may or may not be the same as conspiracy theories and it’s not clear how the researchers ensured that they were indeed the former. Lastly, there is a need to explain how this study links to the topology, as it doesn’t seem to have been used as an analytical framework to analyse the data.

In summary, there are three overarching issues with this paper, whose underlying premise is promising: 1) The conceptual and methodological linkages between the three main portions of this paper (the typology, study 1, and study 2) seem weak in its current form, and thus need elucidation and clarity. 2) The rationale for studies 2 and 3 (and combining them in the same paper) is not clear and intuitive – and even more so, it would be useful to see a justification about how a single focus group can qualify as a whole study, and 3) the main focus of the paper – the typology, needs more robust grounding in the literature surrounding conspiracy theories, and updating to the new COVID-19 context that has tectonically shifted this field.

Is the work clearly and accurately presented and does it cite the current literature?
No

Is the study design appropriate and is the work technically sound?
No

Are sufficient details of methods and analysis provided to allow replication by others?
Partly

If applicable, is the statistical analysis and its interpretation appropriate?
I cannot comment. A qualified statistician is required.

Are all the source data underlying the results available to ensure full reproducibility?
Yes

Are the conclusions drawn adequately supported by the results?
Partly

**Competing Interests:** No competing interests were disclosed.
Reviewer Expertise: 1) Online health misinformation related to infectious disease outbreaks, 2) conflicting information related to public health nutrition.

I confirm that I have read this submission and believe that I have an appropriate level of expertise to state that I do not consider it to be of an acceptable scientific standard, for reasons outlined above.

Reviewer Report 02 September 2021

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Inspired by work in folkloristics, this study creates a typology of 14 health conspiracy theories. This typology provides a classification system with which to study the emergence, evolution and influence of HCTs. This is a very worthwhile research objective it gives researchers in this area a common terminology for these influential beliefs. The manuscript also employs the HTC in a UK study of belief in HCTs. A third study examines a Sri Lankan groups HCT beliefs. While I have a range of suggestions, I generally found the manuscript an interesting read and a very useful contribution to the literature. It will, I hope, facilitate research into the psychological basis and diffusion of these beliefs.

Major comments:

1. Structure
I think the following simpler manuscript structure like this might assist the reader in understanding the research:

Introduction
Study 1: HCT index development
  Methods
  Results
  Discussion
Study 2: Exposure and belief HCTs in the UK
  Methods
  Results
  Discussion
Study 3: HCT beliefs in Sri Lanka
  Methods
  Results
  Discussion
General discussion

At the moment, the main contribution of the manuscript (the creation of the HCT) is not described as a study, and the methods and results are described under a level 1 "Methods" heading.

2. HCT index.

Relatedly, a more detailed description of the methods used to develop the HCT index would be useful. I suggest including additional information about the number of academic sources and non-academic websites etc that the authors searched. More detail about the coding of the conspiracy theories into HCTs would also be useful. Was the index categories created by a single author or by multiple people? Was there agreement? Do independent coders tend to agree with one another about the categorisation of new conspiracy theories into the typology?

3. Study 1

How were the items selected? Was there at least one for each HCT type? The main result here - 49% believe at least 1 HCT - seems to depend on which HCTs formed the stimuli set. Had the vaccination-causes-autism HCT been omitted, the percentage would presumably be much lower. Had some other HCT been included, the percentage may have been higher. This dependence of the result on the stimuli set leaves me a bit uncertain about how to interpret the 49% statistic. Perhaps it would be more informative to just present the percentages for each of the most-believed HCTs in the manuscript rather than the supplementary materials? Or expand Figure 1 to include all items?

When presenting the relationship with education, political affiliation etc, it would be useful to present means as well as p values and chi-statistics so readers understand the effect sizes.

4. Study 2

The authors should clarify in the main manuscript that the topic guide included "ISIS using blood testing as a plot to inject people with HIV" since it is relevant to know that the researchers rather than the participants raised this.

(Aside: in Bangladesh, rickshaw riders are thought to have difficulty conceiving. In the UK, cyclists are thought to have low sperm count - are these also HCTs?).

5. Conceptualisation of HCTs

According to the author's definition, are HCTs necessarily false? There certainly have been cover-ups over disease origins. COVID origins aside, the 1977 H1N1's lab origins was covered up: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4542197/ Experimentation without consent is hardly unheard of either: https://www.irishtimes.com/news/social-affairs/practice-of-vaccine-trials-makes-for-difficult-reading-says-gsk-1.4461552. My belief that these events occurred would seem at face value to meet the author’s definition of a HCT in that I believe that an organisation deliberately and secretly caused harm (GSK vaccine trials) or covered up evidence of harm (lab release). Philosophical work by Quassim Cassam may be helpful in refining the definition: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8161711/
Minor comments:

"Despite familiarity with HCTs and agreement that they were likely to be true only correlated positively with one demographic category, political affiliation was found to affect both familiarity and belief, and this was not in the direction predicted by the correlation.": Rephrase for clarity?

Some "Coding of transcript" content belongs in the methods rather than results: translations etc.

Add a clearer statement of purpose for Study 2.

Potentially relevant study: https://bmjopen.bmj.com/content/8/12/e022825

Is the work clearly and accurately presented and does it cite the current literature?  
Yes

Is the study design appropriate and is the work technically sound?  
Yes

Are sufficient details of methods and analysis provided to allow replication by others?  
Partly

If applicable, is the statistical analysis and its interpretation appropriate?  
Yes

Are all the source data underlying the results available to ensure full reproducibility?  
Yes

Are the conclusions drawn adequately supported by the results?  
Yes

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: I have worked on the cultural evolution of maladaptive health beliefs.

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.