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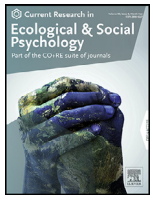

Hygiene Norms Across 56 Nations are Predicted by Self-Control Values and Disease Threat

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ABSTRACT

Three major theories could potentially explain why hygiene norms vary across societies: tightness-looseness theory, disease threat theory, and theory of a civilizing process driven by how self-control is valued. We test these theories using data from a study of 56 countries across the globe, in which almost 20,000 participants reported their norms about spitting in six different contexts, hand washing in six different contexts, and tooth brushing. Participants also reported the perceived tightness of their society, whether they perceived diseases as a threat to their society, and their valuation of self-control. In support of the civilizing process, most of the norms in our study (including most hand washing norms and most spitting norms) were stricter in countries where self-control is valued more highly. A few norms did not follow this main pattern and these norms were instead stricter in countries where disease was perceived as a greater threat. Thus, while the theory of a civilizing process received the strongest support, our data indicate that some combination with the disease threat theory may be required to fully explain country-variation in hygiene norms.

1. Introduction

The strictness of hygiene norms are known to vary across countries (Loughnan et al., 2015; Maes et al., 2006). Stricter here means that fewer actions are permitted and outcomes are delimited. Why are hygiene norms stricter in some countries? This is the question that we address in this paper. Prior literature offers at least three different suggestions. One idea is that all norms, including hygiene norms, are stricter in some "tighter" countries than in other "looser" countries (Gelfand et al., 2011). An alternative theory, from evolutionary psychology, is that specifically hygiene norms are adaptive responses to disease threat (Murray and Schaller, 2012). A third theory, by a classic sociologist, is that the strictness of hygiene norms is an outcome of a "civilizing process" driven by the value that society places on self-control (Elias, 1978). These theories yield different predictions about how hygiene norms will vary across countries. The aim of this study is to test these predictions.

1.1. Studies of hygiene norms in different cultures

Norms can be interpreted as required standards or as expectations within a social setting (Stevenson, 2010). Expectations are beliefs. Common beliefs about what other people do are known as "descriptive" social norms while beliefs about what one should do are known as "injunctive" social norms (Cialdini, 2003). The two types of norms often, but not always, coincide (Eriksson et al., 2015). There are a number of studies mapping hygiene norms within a society. For instance awareness of injunctive hygiene norms have been found to develop at an early age. A Japanese study found that already very young children recognize hygiene norms and are able to give explanations for why the norms are justified (Toyama, 2016). Hygiene norms can also vary within societies. A British study of mothers of small children found that some hygiene standards were higher among poorer and less educated mothers (Sherriff and Golding, 2002). Hygiene norms have also been documented to change over time. For example, an intervention study in Nepal found injunctions helped to form new hygiene norms, moving people away from open defecation and toward increased hand washing (McMichael and Robinson, 2016). Such change of hygiene norms is an important factor for achieving improved hygiene levels in a community (Dreibelbis et al., 2013).

While many studies map hygiene norms within a society, there have been very little empirical investigation of how hygiene norms differ between societies. Societies could differ in their hygiene levels for material reasons (Dreibelbis et al., 2013; McMichael and Robinson, 2016), but many important hygiene behaviors are cheap and widely accessible. Some important examples include tooth brushing, hand washing, and refraining from spitting. Even for these low-tech hygiene behav-

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iors, norms appear to differ between societies. For instance, a study found varying national tooth brushing habits across 32 countries from North America and Europe, including Israel (Maes et al., 2006). The study made no attempt to account for this variation. Hand washing behavior has been surveyed worldwide, indicating a reduced prevalence in low to middle income countries, and an associated disease burden (Loughnan, et al., 2015). However, the data used in this systematic review were collected under various protocols, making detailed comparison of behavioral norms difficult. We are aware of a global survey that measured hand washing practices in one specific context: after using the toilet (Pogrebna and Kharlamov, 2020). For spitting there is almost no rigorous research on how contemporary norms differ between societies. Nevertheless, several authors have noted that spitting appears to be more prevalent in several developing countries than in Western countries, consistent with many Western countries having a history of public campaigns against spitting (Coomber et al., 2018; Grace et al., 2016).

1.2. Theories

The reviewed literature indicates that norms about accessible hygiene behaviors vary across societies, but little is known about exactly how or why. In this section we shall review three theories that make predictions about how hygiene norms vary across societies. As we shall see, all three theories speak to the strictness of hygiene norms in general and therefore implicitly predict that differences in strictness between societies will be consistent across different norms. In other words, when comparing hygiene norms across societies we should find that some societies tend to have stricter hygiene in general. A society that is relatively strict on, say, handwashing after shaking hands should also be relatively strict on, say, not spitting in a public pool. We are not aware of any prior empirical work that assesses this prediction that societies may be meaningfully characterized by the general strictness of their hygiene norms. Because all the theories we cover make this prediction, we state this as our first and most general hypothesis.

H1: At the society level, the strictness of hygiene norms has a one-dimensional structure, that is, some societies will have stricter hygiene norms in general.

The first way of deriving this hypothesis is as a special case of the tightness-looseness theory in cultural psychology (Gelfand et al., 2011). This theory assumes that the general strength of social norms is a cultural adaptation to the extent of social and ecological threat faced by the society, including natural disasters, diseases, lack of natural resources, and threat from territorial invasions. Stronger norms in general are assumed to provide the increased social coordination required to effectively counter these threats. The general strength of norms in a society is conceived as its "tightness". Gelfand et al. (2011) provided a scale to measure the (perceived) tightness of a society. Because hygiene norms are a subset of social norms, the prediction from tightness-looseness theory would be that tighter societies have (among other things) stricter hygiene norms:

H2: Hygiene norms are stricter in tighter societies.

A related theory for the emergence of differences in hygiene norms comes from evolutionary psychology, according to which cultural norms are "evoked" by ecological circumstances (Tooby and Cosmides, 1992). In Schaller's (2006) version of this idea, ecological circumstances will shape what people talk about, which in turn shapes culture. Specifically, Schaller assumes that stimuli related to disease threat lead to particularly strong emotional responses and thereby have an especially strong influence on interpersonal communication and, by extension, on culture. To test this theory, Schaller and colleagues carried out an ambitious research program in which historical levels of pathogens were estimated for a large number of societies and related to various contemporary measures of culture (Fincher et al., 2008; Murray and Schaller, 2010; Murray et al., 2011, 2013; Schaller and Murray, 2008, 2010). Unlike tightness-looseness theory, Schaller's theory explicitly mentions hygiene norms as a specific outcome of disease threat. Namely, the effect of disease threat is expected to be especially pronounced within those specific behavioral domains, such as hygiene, that have especially clear implications for pathogen transmission (Murray and Schaller, 2012). Note that the theoretical pathway outlined by Schaller goes via perception of stimuli related to the disease threat. Thus, Schaller's theory yields the following predictions.

H3: Hygiene norms will be stricter in societies with higher pathogen prevalence and, in particular, higher perceived threat from disease.

Last, we turn to a very different theory of hygiene norms, championed by the German sociologist Norbert Elias. He noted that etiquette books describing desired hygiene practices have been around in Western Europe for several centuries. From the content of the etiquette books, Elias concluded that hygiene norms have gradually become stricter over several hundred years (Elias, 1978). Elias dubbed this gradual change of hygiene norms the "civilizing process". Other researchers have provided additional empirical evidence for the validity of a civilizing process outside of Western Europe (Mennell and Goudsblom, 1997). In addition to observing this empirical phenomenon, Elias (1978) presented a theory for why it arises. His theory is that there has been an underlying cultural shift toward higher expectations of individuals to exercise self-control. The increase in the value placed on self-control was thought to emanate in the ruling classes from which it spread to lower classes. Elias saw this as the outcome of increased interconnectedness between members of society, caused by the emergence of monopolies and central governance which removed people from coercion and consequently a more sophisticated division of labour arose (Linklater and Mennell, 2010). Key outcomes of this process were an increase in hygiene behaviors and a reduction in violence, the latter theme famously picked up by Pinker (2012). Note that we present the theory in its most distilled format; interested readers are referred to more comprehensive summaries (Mennell and Goudsblom, 1997; Linklater and Mennell, 2010). While the shift toward stricter hygiene norms is carefully documented, there is little direct evidence for the proposed mechanism behind this change. However, the mechanism has been descriptively invoked by Elias himself and others. For example, according to a case study of the Netherlands over an 80-year period, "there was a major societal effort from the middle-classes to educate and 'civilize' the working classes, to transfer their own middle-class norms" (Geels, 2005, p. 91).

Elias' (1978) theory is not specific to any particular subdomain of hygiene. Thus, it predicts the one-dimensional structure of the strictness of hygiene norms across societies that we already stated as our general hypothesis (H1). Moreover, the theory that the civilizing process is driven by an increase in the value of self-control and that the same process applies to violence norms yields specific predictions about which societies have stricter hygiene norms:

H4: Hygiene norms will be stricter in societies that value self-control more highly and that have more restrictive norms about violence.

1.3. The current study

In this paper we examine how population-level norms vary across 56 countries, focusing on norms about how often you should brush your teeth, when you should wash your hands, and where you should refrain from spitting. Following how norms are conceived by Elias (1978) and Gelfand et al. (2011), our focus is on injunctive norms, that is, people's beliefs about what you should and should not do. We test H1 to H4 using data collected as part of the International Study of Metanorms (Eriksson et al., 2021). In addition to items on metanorms, this study contained items about hygiene norms, perceived tightness, perceived threat from disease, cultural values related to self-control, and violence norms. The data on hygiene norms have not been published before.

2. Methods

2.1. Participants

For the International Study of Metanorms, local researchers recruited 22,393 participants in major cities in 57 countries (Eriksson et al., 2021). For the current study we excluded Indonesia because of a crucial translation error in the hygiene measure in the Indonesian version of the study. We also excluded participants who had not completed the key measures of hygiene norms and values (see below). This left data on 19,865 participants in 56 countries, comprising 7 African countries, 10 American countries, 17 Asian countries, 21 European countries, and Australia. Most participants were students (79.1%). Consequently, the sample was overall quite young (mean age 25.0 years, with a standard deviation of 9.0 years). The gender composition was somewhat skewed (58.7% women, 30.0% men, and 11.3% with no information on sex). The complete list of countries and sample characteristics per country are given in Supplementary Table 1.

All participants gave their informed consent. All methods were performed in accordance with the relevant guidelines and regulations. Approval of the study protocol was obtained from ethics committees and institutional review boards where required, including: Queen's University (Canada), York University (Canada), Bogotá (Colombia), Institute of Psychology at the Czech Academy of Sciences (Czech Republic), Universidad San Francisco de Quito (Ecuador), United Psychological Research Committee (Hungary), Monk Prayogshala (India), the Trinity College Dublin School of Social Sciences and Philosophy (Ireland), Kwansei Gakuin University (Japan), Aoyama Gakuin University (Japan), United States International University – Africa (Kenya), Sunway University (Malaysia), University of Amsterdam (Netherlands), Komisja ds. Etyki Badań Naukowych Wydziału Psychologii Uniwersytetu SWPS (Poland), Instituto de Ciências Sociais (Portugal), Doha Institute for Graduate Studies (Qatar), Singapore Management University (Singapore), Sungkyunkwan University (South Korea), Universidad de Navarra (Spain), Post Graduate Institute of Medicine (Sri Lanka), Chulalongkorn University (Thailand), American University of Sharjah (United Arab Emirates), University of Kent (United Kingdom), Brunel College of Health and Life Sciences (United Kingdom), University of South Carolina (United States), and New York University (United States).

2.2. Procedure

Participants completed the survey online or, in a couple of countries, on paper. The full set of measures included in the survey is described in the main paper on the International Study of Metanorms (Eriksson et al., 2021) and the materials are available online (https://osf.io/pm5kc/). Below we only describe the measures used in the current study.

2.3. Hygiene norms

Injunctive hygiene norms were measured in three subdomains of hygiene: hand washing norms in 6 different contexts, spitting norms in 6 different contexts, and the norm for tooth brushing frequency. Each norm was measured using a single item, in line with previous research on specific injunctive norms (e.g., Gelfand et al., 2011).

2.3.1. Hand washing

Participants were asked "In which situations do you think people should wash their hands?" with tick boxes for each of six contexts of hand washing: before eating a meal; after eating a meal; after defecating; after urinating; when they come home; after shaking someone's hand. These contexts were selected to represent common situations with relevance for hand washing. For each context we use the percentage of participants in a country who ticked the box as a measure of the national norm; the greater this proportion, the stricter is the norm about hand washing in the specified context.

2.3.2. Spitting

Participants were asked "Where do you think it is not appropriate for people to spit?" with tick boxes for each of six contexts: in the kitchen sink; on the sidewalk; on the kitchen floor; on the soccer field; in the water in a public swimming pool; in the forest. These contexts were selected to represent situations in which spitting is common and/or a relevant hygiene concern. For each situation we use the percentage of participants in a country who ticked the box as a measure of the national norm; the greater this proportion, the stricter is the norm against spitting in the specified context.

2.3.3. Tooth brushing

Participants were asked "How often do you think people should brush their teeth?". The response options were taken from Maes et al. (2006), except the high end of their scale was "more than once a day", which we replaced by separate options for "two times a day" and "three times a day or more". Thus, we offered participants response options coded as follows: never, less than once a week, or at least once a week (coded 0), once a day (1/3), two times a day (2/3), three times a day or more (1). Thus, in our coding we collapse the three low end options, totaling 1.3% of responses. As a measure of the national norm, we use the country mean multiplied by 100 (to be comparable to the percentage measures for hand washing and spitting). We conceive of more frequent tooth brushing as stricter hygiene. Participants were excluded if they had not answered the tooth brushing item.

2.4. Perceived tightness

The study included a six-item scale for the perceived tightness of a society from Gelfand et al. (2011). The items are: "There are many social norms that people are supposed to abide by in this country", "In this country, there are very clear expectations for how people should act in most situations", "People agree upon what behaviors are appropriate versus inappropriate in most situations in this country", "People in this country have a great deal of freedom in deciding how they want to behave in most situations" (reverse coded), "In this country, if someone acts in an inappropriate way, others will strongly disapprove", "People in this country almost always comply with social norms". We use the country scores calculated by Eriksson et al. (2021).

2.5. Historical prevalence of pathogens

We used data on the 7-item index of historical prevalence of pathogens (Murray and Schaller, 2010), which was available for all countries in the study.

2.6. Perceived threat from diseases

The study included a list of potential threats to society: diseases, conflict within the country, conflict with other countries, over-population, food deprivation, lack of safe water, poor quality of air, natural disasters, and immigration. This list was designed to cover the various kinds of threats discussed in tightness-looseness theory (Gelfand et al., 2011). Participants ticked every threat they thought applied to their society. To measure the perceived threat from diseases we use the proportion of participants in a country who ticked "diseases". This measure was not included in the United Arab Emirates and is therefore available for 55 of the 56 countries in the study.

2.7. The value of self-control

We went to Elias' (1978, p. 375) book about the civilizing process to examine what he meant by self-control. He describes a person with self-control (or, interchangeably, self-constraint) as a "super ego", someone who "endeavours to control, transform or suppress his or her affects in keeping with the social structure." To measure how a society

values this personal quality, we use an item included in the International Study of Metanorms as well as in the World Values Survey (WVS) and its companion, the European Values Study (EVS). The latter two surveys together constitute a massive empirical effort to measure how cultural values vary across societies (Inglehart et al., 2000). They include a key question about the valuation of various personal qualities: "Here is a list of qualities that children can be encouraged to learn at home. Which, if any, do you consider to be especially important?" Data from this question have been used in a large number of studies in economics (e.g., Tabellini, 2010), political science (e.g., Granato et al., 1996), cultural psychology (e.g., Minkov and Hofstede, 2012), and well-being (e.g., Lun and Bond, 2013). The exact same question on valuation of personal qualities was also included in the current study. Responses were given using ten tick boxes. (Participants who did not tick any box at all were excluded from the study.) Following the WVS, the response options were labeled independence, hard work, feeling of responsibility, imagination, tolerance and respect for other people, thrift, saving money and things, determination/perseverance, religious faith, unselfishness, and obedience. Here we use these data to measure the value of self-control. Comparing Elias' conception of self-control with the response options above, we found that "feeling of responsibility" came closest, arguably capturing the intention to behave with self-control. We found that "determination/perseverance" came closest, arguably capturing the ability to behave with self-control. We therefore measure the value of self-control in a country by the average of the percentage that ticked "feeling of responsibility" and the percentage of participants that ticked "determination/perseverance". (If we would use only "feeling of responsibility" instead, we obtain almost identical results to those we report here, whereas using only "determination/perseverance" yields qualitatively similar but weaker results.)

2.8. Restrictive violence norms

To measure restrictive violence norms, the study included two items adopted from recent waves of the WVS (World Value Survey Association, 2012). Participants were asked how justifiable it is for a man to beat his wife and to use violence against other people, with responses on a ten-step scale between "always justifiable" (coded 1) and "never justifiable" (coded 10). After calculating the country mean of each item, we averaged them to a country-level measure of restrictive violence norms. This two-item scale had a Spearman-Brown's coefficient of 0.80 (Eisinga et al., 2013).

2.9. Control variables

Our main analyses use the variables presented above but we also check that results are robust when we add controls for sample demographics, response style (with respect to tick box questions) and the socio-economic development of the country. From individual-level data on participants' sex, age, and whether they were students or non-students, we calculated three measures of sample demographics: proportion of students, mean age, and sex ratio (i.e., the ratio of females to males). To measure response style with respect to tick box questions, we used the average number of ticks across the remaining eight boxes for child qualities. Socio-economic development by country was measured by the Human Development Index for 2019 provided by the United Nations Development Programme (http://hdr.undp.org/).

2.10. Analytical strategy

To address the general hypothesis (H1) that country variation in hygiene norms will fall along a single dimension we employ an exploratory factor analysis, which is a standard technique to uncover whether a complex dataset can be reduced to a smaller number of dimensions. For the factors we find, we then examine whether they can be accounted for by tightness (H2), pathogen prevalence and perceived disease threat (H3), and valuations of self-control and violence norms (H4). We do this by first calculating raw correlations and then performing multiple regression analyses. As our hypotheses only speak about the country level, these analyses are performed on country-level aggregates. As a final step, we perform multilevel analyses using mixed effect models to examine the extent to which the main predictors work at the individual level or genuinely at the country-level.

2.11. Data analysis

Analyses were performed in SPSS. All data used in this paper and SPSS syntax files for reproducing all tables and figures are available at https://osf.io/bw5 × 6/.

3. Results

Estimated hygiene norms per country are illustrated in Fig. 1, see Supplementary Table 1 for details. Descriptive statistics are presented in Table 1. Some norms were generally very strict, such as hand washing after defecating and urinating, which were endorsed by more than 90 percent of the sample in the average country. Other norms, such as hand washing after shaking hands and refraining from spitting in the forest, were generally weak. Importantly, all hygiene norms showed considerable variation in strictness across countries.

3.1. The dimensionality of country variation in hygiene norms

To examine the number of dimensions required to account for country variation in hygiene norms, we performed an exploratory factor analysis of the national hygiene norms for the 13 different hygiene behaviors in our study. A scree plot (Supplementary Fig. 1) supported extraction of two factors, accounting for 42.7% and 18.8% of the variance, respectively. This analysis demonstrates that two dimensions may be sufficient to capture most of the variance in hygiene norms, while a single dimension is not. Thus, while our data do not exactly support the hypothesis that all hygiene norms vary across societies along the same dimension (H1), the positive factor loadings in bold in the left column of Table 2 support the related notion that a single dimension is sufficient to capture the variation of most of the hygiene norms, covering spitting in five out of six contexts and covering hand washing in four out of six contexts. These nine norms have very high internal consistency, $\alpha = .90$. Thus, when considering how the three theories account for cross-country variation in hygiene norms (H2-4), the primary focus of our subsequent analyses will be on these nine norms. To simplify reporting of these analyses we calculate a single country score for the "main" level of strictness of hygiene by taking average strictness of the nine norms belonging to the main factor (M = 71.9, SD = 8.8, min = 44.8, max = 82.8).

Five hygiene norms loaded on the secondary factor: hand washing in three contexts, spitting in one context, and tooth brushing with a lower internal consistency than the first factor one, $\alpha = .68$. We calculate a single country score for this secondary factor by taking the strictness of the five norms belonging to it (M = 57.5, SD = 8.7, min = 38.8, max = 77.0).[1] In support of the notion that these norms form a second, orthogonal factor, these scores were essentially uncorrelated with the country scores for the main factor, r = 0.09, 95% CI [-.15, .34]. However, note that the internal consistency of the secondary factor was not nearly as high as for the main factor. With only 56 countries as data points for hygiene norms, the specific factor decomposition we obtained might be unreliable. We therefore treated the second, much smaller factor with caution, especially as it was not clear how it differs conceptually from the main factor. For completeness we therefore also analyze the average strictness of all 13 hygiene norms in our study ($\alpha = .72$; M = 65.2, SD = 6.7, min = 45.7, max = 76.0).

[1] Here we include the cross-loading norm in both factors but results are very similar if we exclude it instead.

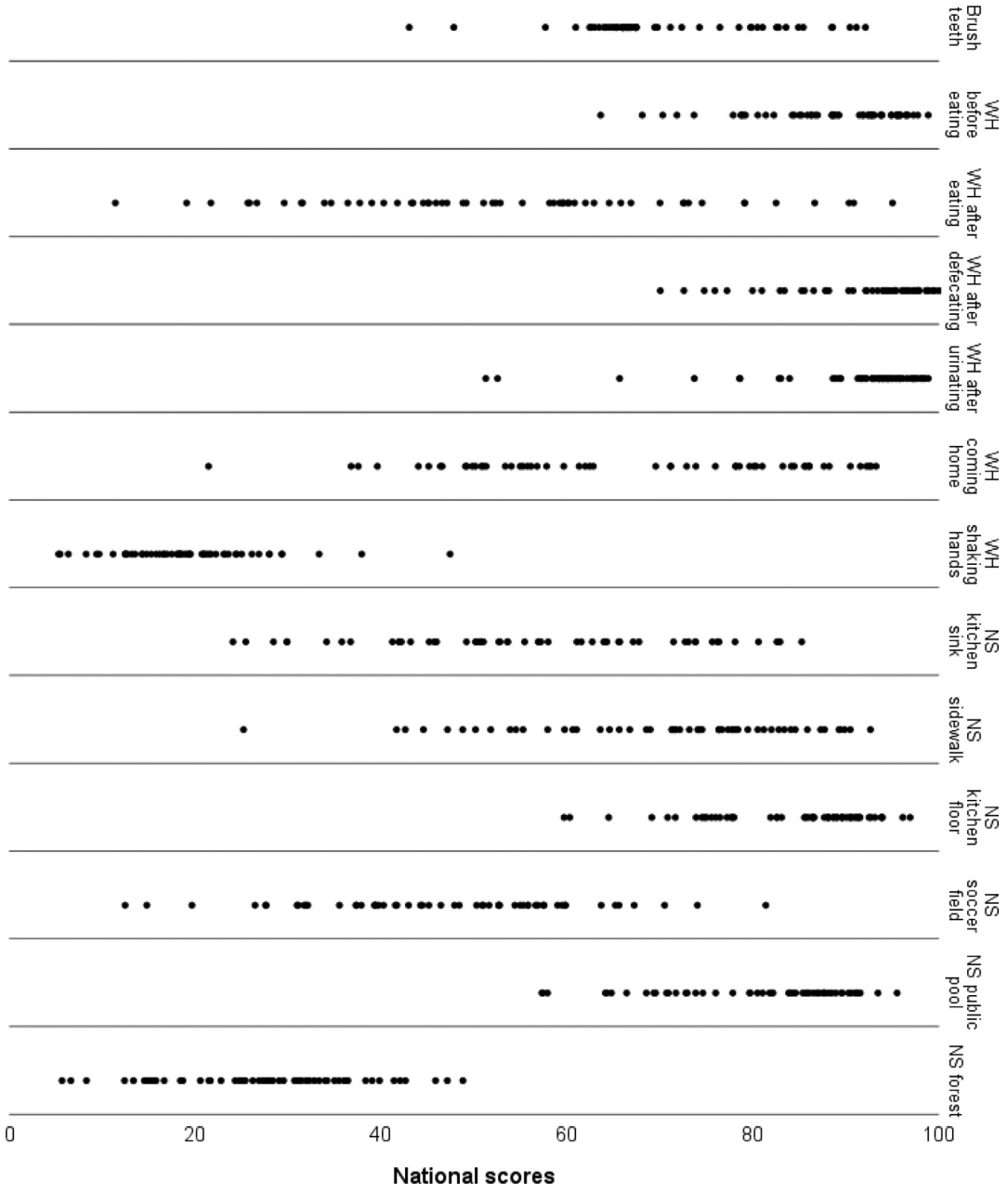

Fig. 1. Dot plots showing the distribution of national strictness scores on each hygiene norm (WH stands for wash hands, NS stands for not spit).

Table 1
Descriptive statistics of strictness of national hygiene norms across 56 nations.

Brush teeth		Wash hands			Not spit		
M	SD		M	SD		M	SD
70.5	10.1	before eating	88.1	8.1	in the kitchen sink	56.6	16.2
		after eating	53.1	19.4	on the sidewalk	70.5	14.7
		after defecating	92.1	7.6	on the kitchen floor	84.2	8.9
		after urinating	90.8	9.9	on the soccer field	46.9	14.4
		when coming home	66.7	18.0	in a public swimming pool	80.5	10.0
		after shaking hands	19.2	7.7	in the forest	27.8	10.3

3.2. The predictors

As predictors of national hygiene norms we use perceived tightness, the historical prevalence of pathogens, the perceived threat of diseases, the value of self-control, and restrictive violence norms. Table 3 reports descriptive statistics, including intercorrelations, for all predictors.

3.3. Correlates of national hygiene norms

Table 4 reports how the strictness of hygiene norms, averaged either across all norms or separately for the main and secondary factor of norms, correlated with the five theoretically motivated predictors. Some hypotheses fared well, others did not.

Table 2
Results of an exploratory factor analysis of national hygiene norms.

Norm	Main factor	Secondary factor
don't spit in the water in a public swimming pool	0.90	0.07
don't spit on the sidewalk	0.88	0.05
don't spit on kitchen floor	0.87	0.10
don't spit on the soccer field	0.76	-0.10
wash hands after urinating	0.72	-0.12
wash hands after defecating	0.72	-0.11
don't spit in the forest	0.66	0.05
wash hands when they come home	0.64	0.06
wash hands before eating a meal	0.50	0.67
don't spit in kitchen sink	0.07	0.89
wash hands after shaking someone's hand	-0.27	0.51
wash hands after eating a meal	-0.17	0.48
brush teeth	0.14	0.48

Note. Factor loadings obtained from principal axis factoring and oblimin rotation with Kaiser normalization. Loadings above .30 in bold.

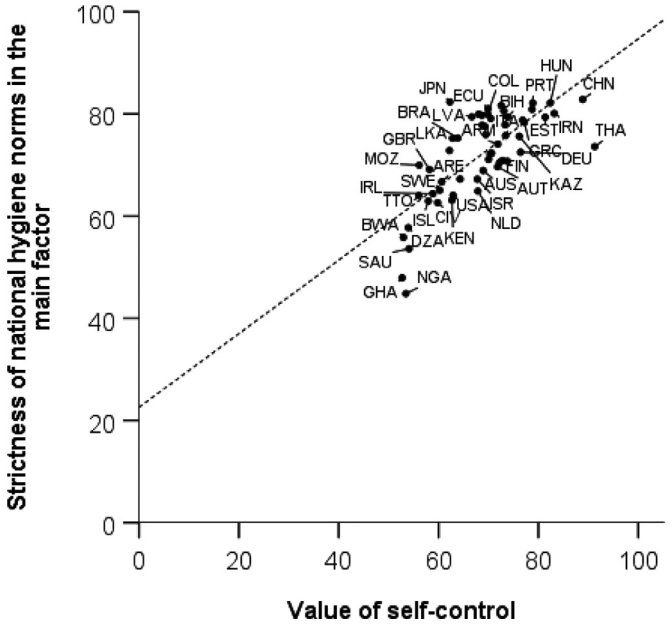

Fig. 2. Mean strictness of national hygiene norms in the main factor plotted against the value of self-control in 56 countries. Including regression line (R^2 = .53).

Note. Correlations with 95% BCa confidence intervals based on 2,000 bootstrap samples and n = 56 countries, except for perceived threat from disease for which n = 55.

Elias' theory about the civilizing process received the strongest support. Consistent with its predictions (H4), societies with higher valuations of self-control and more restrictive norms about violence had stricter hygiene norms on average. If we focus on norms in the main factor, the positive correlation with the value of self-control was extremely strong, see the scatter plot in Fig. 2. On the other hand, hygiene norms in the secondary factor were not predicted by Elias' theory.

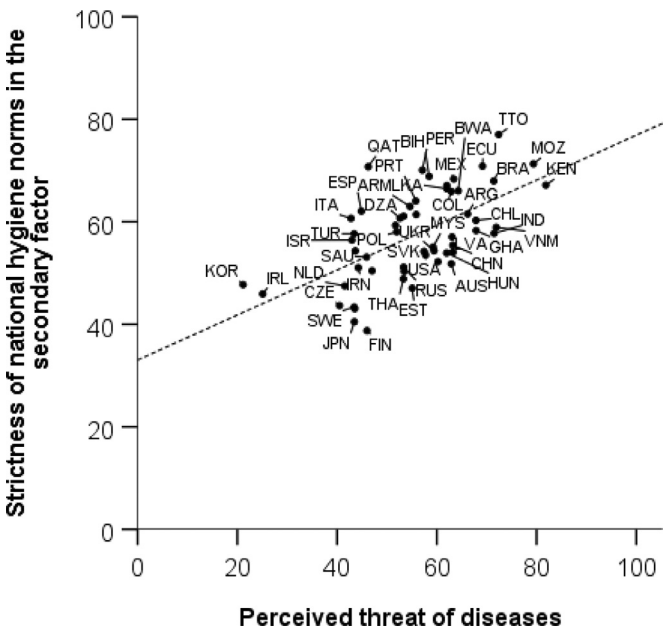

Fig. 3. Mean strictness of national hygiene norms in the secondary factor plotted against the value of self-control in 55 countries. Including regression line (R^2 = .36).

The correlations reported in Table 4 further show that Schaller's theory of hygiene norms being evoked by disease threat was not generally supported in our data. Inconsistent with the predictions from this theory (H3), societies with higher prevalence of pathogens and higher perceived threat did not have stricter hygiene norms on average, nor in the main factor. However, both the historical prevalence of pathogens and currently perceived disease threat correlated with the strictness of hygiene norms in the secondary factor. Indeed, perceived disease threat was a very strong predictor of these norms, see the scatter plot in Fig. 3.

Tightness-looseness theory fared particularly poorly in the correlational analysis reported in Table 4. Inconsistent with the prediction of tightness-looseness theory (H2), hygiene norms tended to be stricter in societies that are looser according to the perceived tightness measure.

3.4. Separate analyses for each hygiene norm

The results of Table 4 indicate that the two factors that came out in our exploratory factor analysis of hygiene norms have a meaningful difference with respect to the theoretically motivated predictors: the strictness of hygiene norms in the main factor correlated with the value of self-control, while the strictness of norms in the secondary factor correlated with perceived threat. We therefore proceeded by checking whether this pattern held separately for each norm, see Table 5. In strong support of the validity of the main factor, every single norm

Table 3
Descriptive statistics of country-level predictors: mean values, standard deviations, and intercorrelations.

	1	2	3	4
1. Perceived tightness (M = 1.97, SD = 0.31)	-			
2. Pathogens, hist. prevalence (M = 0.04, SD = 0.66)	.41	-		
3. Perceived threat from disease (M = 55.6, SD = 12.0)	.14	.48	-	
4. Value of self-control (M = 68.4, SD = 8.9)	-.37	-.16	-.13	-
5. Restrictive violence norms (M = 9.0, SD = 0.5)	-.38	-.32	-.16	.09

Note. Pearson correlations were based on n = 56 countries except for perceived threat from disease for which n = 55.

Table 4
Pearson correlations between the strictness of national hygiene norms and theoretically motivated country-level predictors.

	Correlations with the average strictness of		
Predictor	all 13 hygiene norms	the norms in the main factor	the norms in the secondary factor
Perceived tightness	-.37 [-.61, -.06]**	-.49 [-.69, -.20]***	.08 [-.16, .31]
Pathogens, hist. prevalence	.06 [-.24, .38]	-.17 [-.44, .19]	.47 [.26, .65]***
Perceived threat from disease	.20 [-.04, .44]	-.06 [-.30, .20]	.60 [.42, .72]***
Value of self-control	.55 [.34, .71]***	.73 [.57, .84]***	-.17 [-.41, .10]
Restrictive violence norms	.36 [.16, .54]**	.42 [.20, .64]**	-.01 [-.26, .23]

†: p < .10
*: p < .05
**: p < .01
***: p < .001

Table 5
Pearson correlations with the value of self-control and perceived disease threat for each national hygiene norm.

Norm	Value of self-control (n = 56)	Perceived threat from diseases (n = 55)
don't spit in the water in a public swimming pool	.68***	.05
don't spit on the sidewalk	.74***	-.04
don't spit on kitchen floor	.65***	-.11
don't spit on the soccer field	.62***	-.08
wash hands after urinating	.51***	-.19
wash hands after defecating	.51***	-.27*
don't spit in the forest	.46***	-.13
wash hands when they come home	.52***	-.07
wash hands before eating a meal	.31*	.47***
don't spit in kitchen sink	-.19	.46***
wash hands after shaking someone's hand	-.24†	.48***
wash hands after eating a meal	-.21	.49***
brush teeth	-.11	.19

†: p < .10
*: p < .05
**: p < .01
***: p < .001
Note. Correlations above .30 are in bold. Norms are listed in the same order as in Table 2.

in this factor correlated positively with the value of self-control, while none of the other norms did. The validity of the second factor was similarly supported, although not as strongly, as the positive correlation with perceived disease threat was quite weak for the tooth brushing norm.

3.5. Multiple regression analyses

We complement the previous correlational analyses by multiple regression analyses in which all theoretically motivated predictors as well as the control variables are included as simultaneous predictors of hygiene norms. See Table 6. The results support the previous conclusions: variation in hygiene norms in the main factor is explained by the value of self-control while variation in hygiene norms in the secondary factor is explained by the perceived threat from disease. The control variables had no significant effects and results are similar if they are omitted.

3.6. Multilevel analyses

In a final set of analyses, we include individual-level data and estimate linear mixed-effect models. For simplicity, we focus on the value of self-control and perceived threat from disease, which are the two main predictors we identified in the previous analyses. (Results are similar if other variables are included as well.) At the individual level, the value of self-control is measured as the mean of two binary variables so it has three levels (0, 0.5, and 1). Perceived threat is a binary variable so it has two levels (0 and 1). For each of the two factors of hygiene norms, we estimate two models. Model 1 includes only the country-level variables as predictors and a random intercept at country level. Model 2 additionally includes the individual-level variables. Table 7 reports the fixed effects, comparable to the B values in Table 6. Using Model 1 we replicate the findings in the previous country-level analyses: strictness of hygiene norms in the main factor is predicted by the value of self-control while strictness of hygiene norms in the secondary factor is predicted by perceived threat from disease. Using Model 2, we partition the total country-level effect of each variable into two parts: the part that is a direct consequence of an individual-level effect and the remaining part that is a genuine country-level phenomenon. The results show that, at the individual level, perceived threat from disease and the

Table 6
Multiple linear regressions of the strictness of national hygiene norms in the main factor and the strictness of national hygiene norms in the secondary factor.

	Main factor		Secondary factor	
	B	beta	B	beta
Perceived tightness	-5.8	-.20	-4.8	-.17
Pathogens, hist. prevalence	1.6	.12	3.3	.25
Perceived threat from disease	3.8	.05	28.4	.39*
Value of self-control	57.3	.58***	-7.7	-.08
Restrictive violence norms	5.9	.34***	1.8	.10
Proportion students in sample	4.1	.10	-7.3	-.17
Mean age in sample	0.1	.04	-0.1	-.05
Female:male ratio in sample	0.6	.11	0.5	.10
Response style in sample	-39.5	-.13	14.6	.05
Human Development Index	0.3	.00	-15.2	-.21
R^2 (adjusted R^2)		.71 (.64)		.49 (.37)

†: p < .10
*: p < .05
**: p < .01
***: p < .001
Note. Based on n = 55 countries. B values are unstandardized coefficients, beta values are standardized coefficients. Collinearity was not a major concern; all VIF < 3.3.

Table 7
Fixed effects of mixed-effect models on individual level data.

	Main factor		Secondary factor	
	Model 1	Model 2	Model 1	Model 2
Country level				
Perceived threat from disease	1.7	-3.4	28.6***	22.9**
Value of self-control	71.9***	66.0***	-15.0	-17.5
Individual level				
Perceived threat from disease		5.0***		5.7***
Value of self-control		5.9***		2.5***

†: $p < .10$
*: $p < .05$
**: $p < .01$
***: $p < .001$
Note. Based on n = 55 counties.

value of self-control have small positive effects on the strictness of hygiene norms in both factors. Almost all of the country-level effect of the value of self-control is a genuine country-level phenomenon. This is in line with Elias' theory: It is not an individual's own valuation of self-control that should determine that individual's hygiene norms. Instead, people's hygiene norms should develop in response to the valuation of self-control among people in the society in which they live.

4. Discussion

In this study we have broken new ground by systematically examining cross-cultural variation in 13 hygiene norms within the subdomains of hand washing, spitting, and tooth brushing. For contextualized norms about spitting, almost no data of this kind were available in previous literature. Thus, our survey of national spitting norms is unparalleled. Our study also improves knowledge of national norms about hand hygiene in different contexts. With a sample of almost 20,000 participants across 56 countries, our study is on a different scale than previous cross-cultural studies of multiple hygiene behaviors, such as a recent study of 300 participants in four societies (Brewis and Wutich, 2019). These measures of hygiene norms may be useful to other researchers. For example, the high level of hygiene in modern societies has contributed to increased life expectancy, but at the same time it may have increased the risk for auto-immune and allergic diseases (Beenhouwer, 2018; Liu, 2015). The measures of hygiene strictness that we obtained in the current study could be useful for studying such effects at the country level.

Here we used the data on hygiene norms to test several competing theories on why they would vary across countries. For example, we examined whether the strictness of hygiene norms is captured by Gelfand's measure of the perceived tightness of cultural norms in general. We found that it is not. Thus, to explain hygiene norms it seems we need theories that speak specifically to the hygiene domain. We are aware of two such theories: Schaller's theory of hygiene norms evoked by local levels of disease threat and Elias' theory of a civilizing process driven by an increase in the value that society places on self-control. We discuss the relative success of these theories below.

We expected national hygiene norms to display a one-dimensional structure, that is, that some countries have stricter hygiene norms across the board. This expectation was not fully supported, but almost. Our analysis indicated a two-dimensional structure, but a single dimension was sufficient to account for the country variation in 9 out of 13 hygiene norms in our study. This set of norms included whether you should not spit on the sidewalk, the kitchen floor, the soccer field, the water in a public swimming pool, or in the forest, as well as whether people should wash hands after defecating, after urinating, when they return home, and before eating a meal. The consistency in national norms across this wide range of behaviors supports the premise that a single theory may explain country variation in much, if not all, of the hygiene domain.

4.1. Evidence for Elias' explanation of hygiene norms

Two kinds of evidence emerged that point to Elias' (1978) theory of the civilizing process as the strongest candidate. First, we found that countries that have stricter hygiene norms also tend to have more restrictive norms about violence. This association was uniquely predicted by Elias' theory, according to which the same civilizing process, driven by an increase in the value of self-control, brings about both stricter hygiene and stricter norms against violence. The correlation between hygiene norms and violence norms was moderately strong and constitutes a completely new piece of evidence that better hygiene and less violence go together as they should do according to Elias. (Recall that the hygiene norms were not correlated with tightness this is not due to a norm in general being more strict in some countries, instead it supports Elias theory of a special relationship between these two types of norms. Second, we found that the value of self-control explained more than 50 percent of the variance in the strictness of hygiene norms in the main factor. This association too is uniquely predicted by Elias' theory. As far as we know, this is the most comprehensive test of the civilizing process that has been conducted—and the test was passed.

Our findings also speak to a recent elaboration on the civilizing process by Strimling et al. (2018). They argued that humans have an evolved disposition to be disgusted by bodily fluids due to disease risk, so that exposure to bodily fluids should elicit a strong negative response, in keeping with the behavioral immune system hypothesis (van Leeuwen and Petersen, 2018). Any behavior that reduces risk by restricting exposure should therefore be regarded as less threatening. If such stricter hygiene innovations are initially endorsed by a small subset of the population, they may spread to the rest of the population through peer punishment. The key assumption is that looser behaviors elicit stronger negative responses among others, leading to more peer punishment of looser behaviors than of stricter behaviors, and this asymmetry in who is punished is assumed to bring people into line with the newly innovated norms (Strimling et al., 2018). To tie this theory to the value of self-control, we need to make the additional assumption that a person engaging in unhygienic behavior is generally seen as having low self-control. How likely the behavior is to be punished could then be influenced by how much self-control is valued in that society. This would lead to a stronger asymmetry in punishment in countries that value self-control more, and hence a quicker adoption of stricter hygiene norms in the population. The outcome would be the observed pattern of stricter hygiene norms in societies that put greater value on self-control. The above assumption is still untested and is a question for future research.

4.2. Evidence for Schaller's explanation of hygiene norms

The second major theory of hygiene norms is Schaller's theory that they are evoked by threat from diseases (Schaller, 2006; Murray and Schaller, 2012). For hygiene norms in the main factor, we found no influence of threat levels. This finding suggests that it is often not the salience of a threat that determines beliefs about hygiene, an interpretation in line with Elias' (1978) empirical finding that hygiene norms have long tended to become stricter in Western countries, seemingly without any increase in the prevalence of pathogens. But results shifted when we instead considered the few hygiene norms in the secondary factor: that people should wash their hands after eating a meal and after shaking someone's hand, and that you should not spit in the kitchen sink. These norms were not accounted for by the value of self-control, instead they were well accounted for by the perceived disease threat in the country. A possible interpretation of this finding is that it supports a limited-scope version of Schaller's theory: disease threat evokes a few specific hygiene norms. A problem with this interpretation is that it is unclear why disease threat would be more relevant for these four norms than, say, for hand washing after defecation. Alternatively, there might be a specific cultural explanation for the variation in each of these norms. For example, norms about washing hands after eating could plausibly vary due

to how common it is that people eat with their hands instead of using cutlery or chopsticks. If so, the correlation with disease threat may be spurious. In sum, further research is required to settle whether and why variation in disease threat causes variation in some hygiene norms.

4.3. Limitations

The current study has taken a broad, cross-cultural perspective in order to explore low-tech hygiene norms. We covered 13 hygiene norms across three low-tech hygiene domains (hand washing, spitting, tooth brushing). Although this is a wider range of hygiene norms than any other study we are aware of, it is an important limitation that we do not cover even more domains of low-tech hygiene. For example, it would be very interesting to have measures of norms about washing the whole body, washing clothes, and where and when it is okay to cough, sneeze, and urinate. If such measures are collected in future work, it will enable a more detailed examination of the dimensional structure of hygiene norms and the scope of Elias' and Schaller's theories.

We used nations as the aggregation level for norms. A limitation is that we only covered 56 of the almost 200 nations in the world; African countries and small countries were clearly undersampled. Future work should also consider socioeconomic stratification within countries, which we did not cover. A related limitation is that the sample in each country was rather small and not necessarily representative of their countries. This may lead to measurement errors, both unsystematic (noise) and systematic (bias). For instance, if hygiene norms vary systematically between students and non-students, or between men and women, then the country differences we measure may be attributable to sample composition instead. This is not a major concern for our findings, however, as they were robust when we controlled for sample demographics. Moreover, our samples successfully replicate country-level variation in cultural values found in representative samples (Eriksson et al., 2021; Gerlach and Eriksson, 2021).

We did not collect any data on participants' theoretical knowledge of pathogen transmission, which could potentially influence their hygiene norms. However, it is unlikely that such knowledge could explain the results we obtained, with two norm factors that were orthogonal to each other despite both factors including some norms that seem clearly related to pathogen transmission (e.g., handwashing after defecation in the main factor and handwashing after shaking hands in the secondary factor).

The items we used to measure hygiene norms about when to wash hands and where not to spit were developed for this project and had therefore not been validated in any prior research. Instead, the local researchers who administered the International Study of Metanorms in each country translated the survey to the local language and pilot tested it for understandability and meaningfulness. Thus, these items have been deemed meaningful to participants across cultures. The finding that hygiene norms vary with predictors in theoretically meaningful ways constitute further validation of these measures. Note that our measure of the valuation of self-control was derived from available data under the assumption that self-control amounts to feelings of responsibility and determination/perseverance. This seems close to what Elias (1978) had in mind, but it may still be possible to develop a more nuanced measure in future research.

4.4. Conclusion

This study measured a range of hygiene norms in 56 countries and examined their relation to self-control and threat from disease. Most hygiene norms were stricter in countries where people value self-control more and where norms against violence are stricter. These findings provide novel evidence in favor of Elias' theory of a civilizing process driven by an increasing societal valuation of self-control. A few hygiene norms were instead stricter in countries where people perceive a greater threat from disease, as we would expect from Schaller's theory of disease threat evoking norms about hygiene. Thus, while Elias' theory received the strongest support, our data indicate that some combination with Schaller's theory may be required to fully understand country-variation in hygiene norms. Future research should cover an even wider range of hygiene norms.

Declaration of Competing Interest

The authors declare no competing interests.

Author contributions

KE and PS conceived of the study. KE and TD performed the statistical analyses. KE and TD wrote the paper with critical input from PS. KE revised the paper. All authors approved of the final manuscript.

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