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Socio-economic factors, cultural values, national personality and antibiotics use: A cross-cultural study among European countries

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ABSTRACT

There are considerable cross-national differences in public attitudes towards antibiotics use, use of prescribed antibiotics, and self-medication with antibiotics even within Europe. This study was aimed at investigating the relationships between socio-economic factors, cultural values, national personality characteristics and the antibiotic use in Europe. Data included scores from 27 European countries (14 countries for personality analysis). Correlations between socio-economic variables (Gross National Income per capita, governance quality, life expectancy, mean years of schooling, number of physicians), Hofstede's cultural value dimensions (power distance, individualism, masculinity, uncertainty avoidance, long-term orientation, indulgence), national personality characteristic (extraversion, neuroticism, social desirability) and antibiotic use were calculated and three regression models were constructed. Governance quality ($r = -.51$), mean years of schooling ($r = -.61$), power distance ($r = .59$), masculinity ($r = .53$), and neuroticism ($r = .73$) correlated with antibiotic use. The highest amount of variance in antibiotic use was accounted by the cultural values (65%) followed by socio-economic factors (63%) and personality factors (55%). Results show that socio-economic factors, cultural values and national personality characteristics explain cross-national differences in antibiotic use in Europe. In particular, governance quality, uncertainty avoidance, masculinity and neuroticism were important factors explaining antibiotics use. The findings underline the importance of socio-economic and cultural context in health care and in planning public health interventions.

Introduction

Antibiotics are important medicines widely used both in hospital sector and in community as self-medication [1]. The spread antimicrobial resistance in healthcare settings and in the community threatens the effective prevention and treatment of an ever-increasing range of infections caused by bacteria, parasites, viruses and fungi [2–4]. Increasing bacterial resistance leads to greater difficulties in treating infections and ultimately contributes to increased mortality rates [5,6]. In addition to human costs, treatment of patients with infections due to antimicrobial-resistant organisms have higher costs ($6000–$30,000) than treatment of patients with infections due to antimicrobial- susceptible organisms [5].

World Health Organization (WHO) concludes in its report about antimicrobial resistance that resistance to common bacteria has reached alarming levels in many parts of the world and that in some settings few of the available treatments options remain effective for common infections [4]. In the 2014 report, WHO advocates the correct use of antibiotics by targeting all levels of the health care system from patients and health workers to policymakers and industry [4]. While WHO's suggestions are certainly needed, the successfulness of these policies is likely to vary between different counties due to considerable cross-national differences in public attitudes towards antibiotics use [7–10], use of prescribed antibiotics [11], and self-medication with antibiotics [1]. These differences can be partly explained by different health care structures and policies [12] but also with differences in socio-economic factors [13,14] like population income [15,16] and national culture [17,18]. For example, Goldschmidt emphasized the importance of basic education (not only illness related) for successful medical interventions in eliminating transmissible diseases [19]. Similarly, such economy related factors as number of physicians [16] and

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general health of the population (life expectancy) [18] might also influence the use of antibiotics.

Governance quality and antibiotic use

A recent study reported a statistically significant relationship between corruption and antimicrobial resistance in a sample of 28 European countries [20]. In the same vein, we can assume that the effectiveness of health care policy of a country and, consequently, correct use of antibiotics reflects the quality of governance in the country concerned. Since 1996 World Bank has published Worldwide Governance Indicators (WGI) for measuring six dimensions of governance [21]. These indicators are "Voice and Accountability" (VA), "Political Stability and Absence of Violence" (PV), "Government Effectiveness" (GE), "Regulatory Quality" (RQ), "Rule of Law" (RL) and "Control of Corruption" (CC). The first index, VA, measures in what degree the citizens can participate in selecting their government, have freedom of expression and association, and how free the media is [21]. The second index, PV, refers to the probability that the government will be destabilized or overthrown by violent or unconstitutional means, including political violence and terrorism [21]. The third index, GE, measures the quality of public and civil services, and the degree of their independence from political influence, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies [21]. The RQ index measures the existence of sound policies and regulations that permit and encourage private sector development. The RL measures the extent to which agents have confidence in and follow the rules of society. This includes in particular the quality of contract enforcement, property rights, the quality of police and the courts, as well as the likelihood of violence and crime [21]. Finally, CC measures corruption, i.e. the extent to which public power is applied for private gain including both petty and grand forms of corruption [21]. These six aggregate indicators combine the views of a large number of enterprise, citizens and expert survey respondents in industrial and developing countries. It should be noted, however, the WGI indexes are not separate measures of different aspects of the quality of governance but form together a broad measure of the quality of governance [22]. Therefore, a combined index for the WGI was used in this study.

Cultural factors and antibiotic use: Hofstede's cultural values

Cultural factors have been reported to be related to the consumption of antibiotics as well as to illness behavior in general [7,9,10,17,18,23]. One of the most commonly used measures for culture is Hofstede's model for cultural value dimensions [18,24]. According to Hofstede, culture can be named as "the collective programming of the mind that distinguishes the members of one group or category of people from another" [24]. The center of culture is "a system of societal norms consisting of the value systems (or the mental software) shared by major groups in the population", which emphasizes the fact that values are in the most essential part of national culture and these values are shared by the majority. According to Hofstede, culture is mainly composed of four empirically identified dimensions. These dimensions were power distance (PDI: inequality between people), uncertainty avoidance (UAI: the level of stress in a society related to unknown future), individualism vs. collectivism (IDV: the integration of individuals into primary groups), and masculinity vs. femininity (MAS: the division of emotional roles between males and females). Later, Hofstede and his colleagues added two new dimensions to their cultural model: the long-term orientation (LTO) and indulgence vs. restraint (IND) dimensions [24]. This dimension describes how the society sees its own past while dealing with the challenges of the present and future. Societies with a short-term orientation are normative societies which prefer to maintain traditions and view societal change with suspicion. Societies scoring high on log-term orientation are, on the other hand, more pragmatic and oriented towards future rewards, in particular saving, persistence, and adapting to changing circumstances [24]. Indulgence vs. restraint dimension refers to the extent to which people try to control their desires and impulses. Societies high in indulgence dimension value gratification of basic human drives and enjoying life and having fun whereas societies emphasizing restraint suppress individuals' gratification of needs with strict social norms [24]. Hofstede's model has been used earlier in few studies about antibiotics use and infection control [17,25–29].

National personality characteristics and antibiotics use: Eysenck's personality dimensions

In the same way as countries differ in terms of values, research shows that countries differ in term of dominant personality characteristics [30]. Eysenck's personality model includes such dimensions as neuroticism (i.e., emotional instability and high levels of negative affect like depression and anxiety), extraversion (i.e., being outgoing, talkative, and high on positive affect), and psychoticism (i.e., personality characterized with tough-mindedness, non-conformity, inconsideration, recklessness, hostility, anger and impulsiveness) [31]. Eysenck Personality Questionnaire (EPQ) includes also a Lie scale for measuring tendency to socially desirable responding. Cross-cultural studies about the EPQ scales have showed that Extraversion and Neuroticism scales of EPQ are valid and reliable measures of personality across countries while Psychoticism scale seems to show lower reliability [32]. The relationship between antibiotic consumption and personality factors has not been studied earlier.

Aims of the study

The aim of the present study was to investigate the relationships between antibiotic use and socio-economic, national personality characteristics and cultural factors. Following hypotheses were formed:

1) Higher antibiotic use should be related to following socio-economic variables: lower income per capita (Gross National Income per capita, i.e. GNI), lower level of governance quality, lower number of physicians per capita, lower level of education (mean years of schooling), and lower level of national health (life expectancy).
2) Higher antibiotic use should be positively related to cultural values of power distance, collectivism, masculinity, uncertainty avoidance, and short-term orientation. Indulgence as value should have no relationship to antibiotic use.
3) Higher antibiotic use should be positively related to neuroticism and lie scale (social conformism) whereas extraversion should not be related to antibiotic use.

The rationale behind these hypotheses is that antibiotic medicines are relatively easy to access and inexpensive (at least for Europeans) and, thus, they are used as coping strategy to regulate uncertainty and anxiety related to being ill especially when the healthcare sector lacks coordination and resources.

Methods

Measures of antibiotic use

Five indicators for antibiotic consumption in the community (primary care sector) in Europe 2013 were downloaded from

ESAC [33]. These indicators included consumption of antibacterials for systemic use (J01); penicillins (J01C); cephalosporins (J01D); macrolides, lincosamides, streptogramins (J01F); and quinolones (J01M) in DDD per 1000 inhabitants and per day. While ESAC database includes these values for 31 countries, 27 countries were included in the study because of lacking Hofstede value dimensions for four countries. The 27 countries included in the study were Austria, Belgium, Bulgaria, Croatia, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Malta, Netherlands, Norway, Poland, Romania, Slovakia, Slovenia, Spain, Sweden and the United Kingdom. Since we needed a general indicator for antibiotic use, the indicators were subjected to principal component analysis. Parallel analysis and scree plot indicated that one factor solution was the most appropriate. The component confidents (i.e. factor loadings) were .94 for J01, .76 for J01C, .80 for J01D, .78 for J01F, and .81 for J01M, which indicates that the five indicators of antibiotic use formed one single component (labelled as "antibiotic use") to which each indicator was strongly related to. The one-component solution had eigenvalue of 3.34 and accounted for 66.8% of the variance. The alpha reliability coefficient of the scale was .77, which indicates respectable level of reliability [34].

Socio-economic variables

Since earlier studies have reported that antibiotic consumption (as any consumption) is influenced by economic and social situation of the country, we included following variables in the study: GNP per capita (2011) [16,35], mean years of schooling (2012) [16], life expectancy at birth (2013) [18], and the number of physicians per 1000 population (2013 or the last year available) [16]. In addition to these basic variables reflecting national income per capita (GNI), education and health, six governance indicators for 2009–2013 were downloaded from World Bank [36]. Averages of six indicators (years 2009–2013) were calculated to minimize annual variation. The final six governance quality indexes were subjected to principal component analysis. Based on parallel analysis and the Scree plot, one component was finally extracted. The component confidents (i.e. factor loadings) were .98 for VA, .68 for PS, .92 for RQ, .98 for RL, .97 for CC, and .98 for GE indicating that the six indexes measured a common construct which can be labelled as "governance quality". The one-component (eigenvalue 5.15) solution accounted for 85.8% of variance and had alpha reliability coefficient of .96 indicating excellent reliability [34].

Cultural values and national personality characteristics

Six Hofstede value dimensions (PDI, UAI, IDV, MAS, IND, LTO) were downloaded from Hofstede's website. Full set of these dimensions were available for 26 countries (Iceland did not have PDI, UAI, IDV, and MAS scores).

National personality characteristics were measured with Eysenck Personality Questionnaire (EPQ) and the data were obtained from van Hemert et al. [32]. The EPQ data were available for only 14 countries.

Analyses

The study was based on an ecological (correlational) design using cross-sectional analyses. The data were analyzed by using Pearson product-moment correlations and multiple regression analysis. In correlation analyses, correlations between five socio-economic variables, six cultural value scores, and three national personality characteristic scores and sum score of antibiotic use per capita were calculated. In regression analyses, three regression models (socio-economic factors, cultural values, personality scores) were calculated to explain national antibiotic use rates. Since the sample size is inevitably small (27 countries in this study for socio-economic and cultural value analyses and 14 countries for personality) and, therefore, estimates can be unreliable, all statistical analyses were based on bootstrap method (2000 samples, bias corrected estimates) which provides reliable estimates even when the sample size is small.

Results

Correlations between study variables and antibiotic use

Correlation coefficients between socio-economic variables, cultural values, national personality characteristics and antibiotic consumption can be seen in Table 1. Investigation of bootstrap corrected P-values and confidence intervals show that governance quality and mean years of schooling had a statistically significant negative relationship to antibiotic use. Power distance, uncertainty avoidance, masculinity and neuroticism were positively related to antibiotic use rates. Although social desirability (tendency to lie and give a socially positive impression of oneself) had a statistically significant correlation with antibiotic use, the confidence interval values did not prove this finding. Hence, the relationship between social desirability and antibiotic use remains unclear.

Multiple regression models for predicting antibiotic consumption

While correlation coefficients are informative about individual independent variables' relationship to the dependent variable, correlation coefficients do not take into account the effect of other variables, which can change the final results drastically. Therefore, three regression models with bootstrap corrected estimates were calculated. Table 2 shows the results of the tree models: model 1 for socio-economic factors, model 2 for cultural values and model 3 for personality.

Table 2 shows that the highest amount of variance in antibiotic use was accounted by the cultural values (65%) followed by socio-economic factors (63%) and personality factors (55%). Statistically significant factors related to antibiotic use were governance quality, life expectancy and masculinity. The t-test of regression coefficients of individual variables showed a statistically significant value for extraversion but this finding did not hold when the confidence intervals were investigated. On the other hand, the effect of uncertainty avoidance was significant in 5.9% level (i.e. over the cut-off of $P < .05$) and neuroticism in 5.8% level but both these variables

Table 1
Pearson correlation coefficients between antibiotic use and study variables.

Variable	R	SE	CI 95%
Gross National Income (GNI)	−.36	.15	−.58 to −.05
Governance quality	−.51**	.14	−.74 to −.18
Life expectancy at birth	.07	.20	−.33 to .44
Mean years of schooling	−.61***	.10	−.77 to −.40
Number of physicians	.29	.24	−.17 to .61
Power distance (PDI)	.59***	.10	.37–.79
Individualism (IND)	−.34	.19	−.68 to .04
Masculinity (MAS)	.53**	.13	.20–.78
Uncertainty avoidance (UAI)	.63***	.13	.37–.81
Long-term orientation (LTO)	.01	.17	−.31 to .33
Indulgence vs. restrain (IDV)	−.19	.19	−.54 to .19
Extraversion (E)	−.02	.37	−.67 to .60
Neuroticism (N)	.73**	.11	.47–.95
Social desirability (EPQ-L)	.61*	.26	−.05 to .85

Note: Bootstrap estimation based on 2000 samples and bias corrected estimates.
* $P < .05$.
** $P < .01$.
*** $P < .001$

Table 2
Bootstrap regression models exploring predictors of antibiotic use: socio-economic factors, national cultural values and personality.

Variables	B	β	SE	t	*P*	95% CI
Model 1: socio-economic factors[a]						
Gross National Income (GNI)	.00	−.17	.00	−.48	.486	.00–.00
Governance Quality	−.57	−.59	.30	−2.10	.023	−1.11 to −.15
Life expectancy at birth	.16	.54	.08	2.25	.030	.01–.27
Mean years of schooling	−.20	−.19	.18	−.95	.229	−.51 to .07
Number of physicians	.21	.19	.21	1.06	.249	−.17 to .48
Model 2: cultural values[b]						
Power distance (PDI)	.02	.36	.01	1.81	.052	−.01 to .04
Individualism (IND)	.00	.04	.02	.19	.877	−.03 to .03
Masculinity (MAS)	.01	.37	.01	2.46	.046	.00–.03
Uncertainty avoidance (UAI)	.02	.44	.01	2.48	.059	.00–.04
Long-term orientation (LTO)	−.01	−.15	.01	−.91	.415	−.04 to .01
Indulgence vs. restrain (IVR)	.01	.13	.01	.72	.526	−.02 to .03
Model 3: personality[c]						
Extraversion (E)	−.23	−4.06	.10	−3.32	.022	−.45 to .02
Neuroticism (N)	.15	2.07	.14	1.99	.058	.08–.37
Social desirability (L)	.17	2.02	.13	1.50	.146	−.10 to .41

Note: Bootstrap estimation based on 2000 samples and bias corrected estimates.
[a] $F(5,20) = 6.93$, $P < .001$; $R^2 = .63$.
[b] $F(6,19) = 5.86$, $P < .001$; $R^2 = .65$.
[c] $F(3,10) = 4.07$, $P = .04$; $R^2 = .55$.

had confidence interval values indicating a statistically significant relationship. In the case of conflict between P-values and confidence intervals, priority should be given to confidence intervals in interpretation of the results [37,38].

Discussion

The results of the present study confirmed the earlier findings that uncertainty avoidance [17,18,20,25,26]. and masculinity [17,25] are related to inappropriate use of antibiotics. While having a strong correlation with antibiotic consumption (Table 1), power distance did not emerge as that strong predictor of antibiotic use in the regression analysis (Model 2 in Table 2). These results are in line with the study by Deschepper et al. in which power distance correlated strongly with antibiotic use but its partial correlation coefficient was not statistically significant when GDP per capita was controlled [17]. In a study based on Eurobarometer survey, the power distance correlated only weakly ($r = .37$, $P = NS$) with self-reported antibiotic use for cold, flu or sore throat [25]. These differences in results can be explained mostly by different analysis methods (correlation, partial correlation or regression analysis), different measure of antibiotic use (e.g., self-report, distribution or reimbursement statistics) and partly by different set of countries. Interestingly, findings about masculinity, uncertainty avoidance and power distance seem to apply also in the effectiveness of infection control and prevalence of MRSA [27,28]. The individualism, long-term orientation and indulgence vs. restrain dimensions of Hofstede's model do not seem to be related to antibiotics use [17,25]. This might partly be explained by the selection of the countries for analysis. Almost all studies include only European countries which are clearly more or less individualistic and also score similarly in long-term orientation and indulgence. If the data had included truly collectivistic countries like countries from Far-East or Africa, the results about individualism-collectivism and long-term orientation could have been different.

According to our knowledge, the present study is the first study about national personality characteristics (i.e., EPQ) and antibiotic use. In correlation and regression analysis, neuroticism (in 6% significance level) seemed to be related to antibiotic use. This indicates that countries with high level of negative affect such as depression and anxiety as well as moodiness and irritability use antibiotics to cope with anxiety, worry and uncertainty related to illness. The "psychological use" of antibiotics has attracted relatively little attention and should be taken into account when planning countermeasures for unnecessary use of antibiotics. More studies about the relationship between personality characteristics and antibiotic use in both country-level and in individual level are needed.

The most interesting result in this study was that education level as mean years of schooling and governance quality were related to antibiotic use so that countries with higher antibiotic consumption were less educated and poorly managed. In earlier studies, both national income per capita (GDP or GNI per capita) and the level of general education have been reported to have an inverse relationship to antibiotic use [13]. In addition, general health care policies and specific antibiotic campaigns have a positive impact on correct use of antibiotics in communities [12,13,39–41]. In the present study, governance quality was strongly and negatively related to antibiotic use both in correlation and regression models. Governance quality index is composed of such measures as voice and accountability, political stability and absence of violence, government effectiveness, regulatory quality, rule of law and control of corruption [36]. Negative correlation between governance quality and antibiotic use indicates that countries with high levels of corruption and political instability as well as low respect for laws and regulations combined with non-democratic management style have higher antibiotic consumption rates. This might be due to fact that badly managed countries also fail in their health policies and, consequently, in regulation of antibiotic use. Health care policies are essential in providing effective primary care services [41] including correct use of antibiotics.

The results of this study draw a clear and consistent profile of countries with high and low antibiotics use. Appropriate use of antibiotics is more common in countries with low level of societal tension and negative affect (low EPQ N), high tolerance to uncertainty and different lifestyles (low UAI) and "tender" culture with emphasis on cooperation and caring for the weak and quality of life (low MAS). Countries with low antibiotic use in community are also characterized with higher equality in society (low PDI) in which the physician is seen rather as a helper than a person with high status and authority, which is reflected in patient-doctor communication [17]. Since the national cultural values or personality characteristics are slow or impossible to change, the main tool for reducing the (negative) effects of culture on patient-doctor relationship and

antibiotic use is the education given in medical and nursing schools. If the forthcoming physicians, nurses and pharmacists are aware of the influence of such cultural characteristics as power distance or uncertainty avoidance on the behavior and expectations of their patients and, thus, their daily practice, they might also more likely to follow guidelines, for example, for appropriate use of antimicrobial agents.

Low antibiotic consumption countries are also well-governed with effective health policies and higher level of education. These results should be taken into account when developing intervention and policies for promoting appropriate use of antibiotics [4,18]. While improving the governance quality of a country is a long and difficult process, the agents of interventions for improving correct antibiotic use should take into account the governance quality in the countries in which the intervention is applied. If the target country has high score in corruption and inefficient management, it is especially important to design strategies for controlling the prescription and dispensation of antibiotics in grassroots level, i.e. in local pharmacies and GPs' offices. An earlier study shows, for example, that availability of antibiotics without prescription increases the probability of self-medication while the exact dispensation of prescribed tablet quantities by pharmacies decreases it [15]. Moreover, training courses about antimicrobial management and therapy for health care personnel might be an effective way to improve the quality of antibiotic use even in countries with lower governance quality.

Before conclusions, some limitations of the study should be paid attention to. This study was based on aggregated cross-sectional country-level data which were analyzed by using correlational (ecological) design. In addition to the inevitable fact that country level data analysis is often based on small sample sizes, there is also a risk of ecological fallacy in the interpretations. While correlations found in aggregated level analyses can be meaningful and reflect the universal phenomena, we still cannot conclude that these results hold in the level of individual doctors and patients or even individual countries. As not all collectivist countries are low-income countries, it is also possible that, for example, uncertainty avoidance does not always lead to high antibiotic use. The influence of socio-cultural factors on antibiotic use might be mediated by governance quality or more specifically the health care policy which, in turn, determines the regulation of antibiotics use and dispensation. In future studies, more sophisticated mediator-moderator models are needed for explaining the role of socio-economic factors on antibiotic use. These phenomena are more complex when studied in grass root level; findings obtained in country-level might not replicate when studied in individual level. Therefore, both individual and country-level studies are needed in future for fully understanding the mechanisms behind inappropriate use of antibiotics.

Conclusions

Results of this study show that education level and governance quality, cultural values "masculinity" and "uncertainty avoidance", and national personality characteristic "neuroticism" were related to antibiotic use in a sample of European countries. This is understandable, because antibiotic use in primary health care settings in a behavioral issue after all and, thus, influenced by national and cultural characteristics. This should be taken into account when designing public health strategies and interventions to reduce inappropriate use of antibiotics.

Probably the most important and novel finding of this study was the strong relationship between governance quality and antibiotic use. This finding underlines the importance of socio-economic and political context in health care. A well-governed country is also likely to apply effective health policies and, consequently, control of antibiotic use. Such political measures as control of corruption and impartial justice system, promotion of human rights and freedom of speech, and involvement of citizens in decision-making are likely to promote appropriate use of antibiotics.

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