Hofstede's Cultural Values and Birth Rate and Longevity: A National-Level Analysis

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Abstract:

The present study investigated the association between Hofstede's cultural values and societal aging indicators. Longevity and birth rate data for 59 countries and regions from the 1990s, 2000s, and 2010s were used. Multiple regression analyses were conducted, adjusted for the gross domestic product (GDP) per capita and gender gaps in higher education and workforce participation. Uncertainty avoidance (UA) was positively associated with the percentage of older adults in all three decades and negatively associated with the total fertility rate in the 1990s. Interactions between UA and GDP were significant for the percentage of female older adults in the 1990s and 2000s, male and female life expectancy, and the total fertility rate in the 1990s. UA was positively associated with life expectancy and negatively associated with the total fertility rate in countries with higher GDP, but not in countries with lower GDP. UA may therefore be a key cultural value for aging societies.

Keywords: uncertainty avoidance | GDP | ecological study | individualism | power distance

Article:

Introduction

Developed countries are facing population aging, and there are several reasons that have been suggested to explain why. One such reason is economic development, which is associated with longevity. For example, life expectancy positively correlates with gross domestic product (GDP) (World Bank, 2015a, 2015b). Other factors (e.g., geographical, genetic, and cultural differences) may influence health status. Culture may affect cognition, behavior, and motivation (Markus & Kitayama, 1991). A previous study revealed that more masculine-oriented cultures were associated with higher male mortality rates (Stanistreet et al., 2005). In another study, individualism modified associations between individuals' well-being and mortality risk from cardiovascular diseases in European countries (Okely et al., 2017).

　　　　Hofstede's model (Hofstede, 1980) of cultural values dominates the field of cross-cultural research (cf., Taras et al., 2009). This model of cultural values was based on an examination of

data from over 50 countries and regions between 1973 and 1976. Data were collected using a questionnaire that covered a broad range of work-related attitudes and beliefs. Hofstede originally identified four cultural dimensions: power distance, individualism-collectivism, masculinity-femininity, and uncertainty avoidance. Power distance was defined as the extent to which less powerful members of organizations and institutions accept and expect the unequal distribution of power (Hofstede, 1980, 1994, 2001; Steel & Taras, 2010). Individualism was defined as the degree to which people in a country prefer to act as individuals rather than as members of a group (Hofstede, 1994; Steel & Taras, 2010). Masculinity reflects the degree to which masculine values predominate (e.g., in advancement, earnings, training, and up-to-datedness), with feminine values reflecting factors such as a friendly atmosphere, position security, physical condition, and cooperation (Hofstede, 1994; Steel & Taras, 2010). These gender roles tend to be distinct in highly masculine cultures. Finally, uncertainty avoidance was defined as the extent to which people are made nervous by situations they perceive as unstructured, unclear, or unpredictable (Steel & Taras, 2010). Later, another two dimensions were added in collaboration with colleagues. Long-term-short-term orientation was added based on a study of Confucian values in collaboration with Michael Bond (Hofstede & Bond, 1988). Indulgence restraint was added more recently based on collaborative work involving Gert Hofstede and Michel Minkov (Hofstede et al., 2010). Hofstede (2001) treated culture as the collective programming of the mind that distinguishes the members of one group or category of people from another.

Gaygisiz (2009, 2010) investigated associations between Hofstede's cultural values and mortality risks from traffic accidents. Countries with high mortality from traffic accidents were higher in power distance and uncertainty avoidance and lower in individualism than those with low mortality from traffic accidents (Gaygisiz, 2009). Power distance was the strongest cultural dimension for overall healthcare satisfaction (Borisova et al., 2017). In terms of infection control behavior in European countries, elements of compatibility with cultures were low in uncertainty avoidance and power distance, but high in individualism and masculinity (Borg, 2014). In terms of poor medical communication, higher power distance, uncertainty avoidance, and masculinity, along with national wealth, were found to be key cultural dimensions in European countries (Meeuwesen et al., 2009). Previous studies related to health outcomes focused on four cultural dimensions: power distance, individualism-collectivism, masculinity-femininity, and uncertainty avoidance. Long-term-short-term orientation was often excluded from analyses because scores for long-term orientation were reported for fewer countries, meaning limited data were available compared with the original four dimensions (Meeuwesen et al., 2009). Therefore, the present study focused on Hofstede's four fundamental cultural dimensions.

Several studies focused on cultural effects on the birth rate have investigated the relationship between birth rate and female workforce participation (Ahn & Mira, 2002; Lee et al., 2015). In developed countries, the female workforce participation rate was negatively correlated with total fertility rates during the 1970s and early 1980s, but the correlation became positive in the late 1980s (Ahn & Mira, 2002). During the 1970s and early 1980s, "gender role" differences for men and women were clear, and working women might not have had enough time to bear children. However, after the late 1980s, working women had greater leeway to rear children if they were able to purchase childcare services (Ahn & Mira, 2002). Both national wealth levels and gender equality levels may affect birth rates. A multi-level meta-analysis showed that national and individual cultural values could be determined by age, gender, education, and socioeconomic status at the individual level, as well as wealth and freedom at the national level (Steel & Taras, 2010). For example, the power distance and masculinity cultural values were significantly affected

by gender in countries with high gender inequality, but not in those with low gender inequality. A higher birth rate is expected in countries that have higher power distance and masculine cultural values with clearly specified and differentiated gender roles; for example, "men go to work, and women stay at home." However, to our knowledge, no previous studies investigated the association between Hofstede's cultural dimensions and birth rate.

National indices of population aging vary over decades across countries, but some common trends have been observed among developed countries, including Japan. For example, between 1947 and 2016, death rates in Japan, the United States, the United Kingdom, France, Italy, Korea, and other selected countries appeared to plateau from 1960 to 1980, but increased after around 1990 (Japanese Ministry of Health, Labour and Welfare, 2018). Conversely, birth rates started rapidly decreasing around the middle of 1960 through 1980 and appeared to continue to decline slowly until recent years (Japan Ministry of Health, Labour and Welfare, 2018). In addition, trends in natural change rates of the Japanese population indicated zero in the middle of the 2000s (Japan Ministry of Health, Labour, and Welfare, 2018). Therefore, we selected three decades (the 1990s, 2000s, and 2010s) to analyze longevity and birth rate indices.

The present study aimed to investigate whether national cultural values (Hofstede's fundamental four dimensions of culture) were predictive of low birth rate and longevity.Furthermore, the present study investigated whether the four cultural values are significantly associated with longevity in the more recent decades. Based on a study by Gaygisiz (2009), higher power distance and uncertainty avoidance, and lower individualism may be associated with longevity and birth rate indices. In previous studies (Okely et al., 2017; Steel & Taras, 2010), power distance and masculinity were associated with gender inequality, which may be associated with shorter life expectancy and a higher fertility rate. Furthermore, previous studies (Hofstede, 2001; Steel & Taras, 2010) showed that individualism was positively associated with national wealth, which was also associated with longer life expectancy, lower fertility rate, and a higher percentage of older adults. Because GDP may be significantly associated with longevity and birth rate, we also tested whether GDP moderated or mediated the associations between cultural values and longevity and birth rate.

Method

Measurements

This study used an ecological design. We used power distance, individualism, masculinity, and uncertainty avoidance scores for 59 countries or regions (Appendix 1) of Hofstede's cultural value survey. This included "13 index score estimates for countries not in the IBM set" (Hofstede, 2001, pp. 500–501), as well as the outcome variables as explained below. After excluding missing data, 58 countries were included in the analyses for life expectancy, and 56 countries were included in the analyses for total fertility rate. Hofstede's database compiled survey results that were collected from subsidiaries of a large multinational business organization (IBM) and covered many questions about values (Hofstede, 2001).

The present study used the original scores from Hofstede's model. The four cultural value scores ranged from 0 to 100. Averages (SDs) of the cultural values were as follows: 55.2 (22.6) for power distance, 45.3 (26.4) for individualism, 49.2 (19.1) for masculinity, and 65.7 (25.0) for uncertainty avoidance.

Percentages of older adults (those aged 65 and above) by males and females for 1995, 2005, and 2015 were obtained from the World Bank (2015a, 2015b). Life expectancy rates for males and females (excluding Hong Kong) in the 1990s, 2000s, and 2010s were obtained from the World Health Organization's "World Health Statistics" (1996, 2007, 2017). The total fertility rates were obtained from the United Nations International Children's Emergency Fund "State of the World's Children" report (UNICEF, 1996, 2007, 2016).

We adjusted for several variables that may confound the associations between cultural values, longevity indices, and birth rate based on previous studies (Ahn & Mira, 2002; Steel & Taras, 2010). We used GDP based on purchasing power parity per capita (US dollars) in 1990 from the United Nation's "National Accounts Estimates of Main Aggregates. (United Nations, 2018)." Gender gaps in high educational attainment and labor force participation rates were considered gender equality indices. The high educational attainment rate gender gap was calculated as a gender ratio of secondary and tertiary education attainment percentages of the population aged 25 years and over. Percentages of secondary and tertiary education attainment in 1990 for males and females were obtained from the Barro–Lee Educational Attainment Dataset (2018). The gender gap in labor force participation was calculated as a gender ratio using percentages of the working population. The labor force participation rates in 1990 were obtained from the International Labour Organization (2018).

Statistical Analyses

Given the distributions according to the Kolmogorov–Smirnov test for normality, natural log transformation was applied for the percentage of older adults, life expectancy, total fertility rate, GDP per capita, the gender gap in high educational attainment, and the gender gap in labor force participation before the statistical analyses. Geometric means were calculated for GDP per capita, the gender gap in high educational attainment, and the gender gap in labor force participation. Multiple regression analyses were performed to examine associations between cultural values and longevity indices, adjusted for GDP per capita, the gender gap in high educational attainment, and the gender gap in labor force participation. Multiple regression analyses were performed to examine associations between cultural values and total fertility rate, adjusted for the confounding factors. An interaction term reflecting a multiplicative variable of uncertainty avoidance and GDP per capita was entered into the model. Continuous variables were mean-centered, and graphical displays of the regression models were created to further examine the effects of interaction (Jaccard et al., 1990). A slope analysis was used to compare associations between uncertainty avoidance and outcome variables in countries with high GDP per capita (+ 1 SD) and low GDP per capita (− 1 SD). Regression lines and predicted values illustrating interactions were constructed from the intercepts, unstandardized regression coefficients, mean values, and SD values (Cohen et al., 2003). Scores were plotted at the mean, typically low (one SD below the mean), and typically high (one SD above the mean) (Takaki, 2013). The mediation model for GDP per capita between uncertainty avoidance and outcome variables was also investigated using PROCESS version 4.3. All tests were two-tailed, and $p < 0.05$ was considered statistically significant. Statistical analyses were performed using SPSS version 24.0 (SPSS, Chicago, IL, USA).

Results

The variance inflation factors (VIFs) for the explanatory variables in our multiple regression analysis were low (< 3.0 for all), suggesting there were no multicollinearity problems. The set of cultural values, GDP per capita, and gender gap indices significantly explained the percentages of older adults (Table 1) and life expectancy (Table 2) for males and females.

With regard to the contribution of individual variables, uncertainty avoidance was positively associated with the percentage of older adults in all three decades for both males and females. Individualism was also positively associated with the percentage of older adults in the 1990s for males, and in the 1990s and 2000s for females. When an interaction between uncertainty avoidance and GDP per capita was entered into the models, there were significant associations with the percentage of older adults among females for the 1990s ($\beta = 2.03$, p$= 0.011$) and 2000s ($\beta = 1.98$ p$= 0.018$). No interaction effects of other cultural values and GDP per capita showed significant associations.

The regression lines show the interaction effects of uncertainty avoidance and GDP per capita on the percentage of older adults (Fig. 1). The slope analysis showed that in countries with high GDP per capita ($+ 1$ SD), there were significant positive associations between uncertainty avoidance and the percentage of older adults among females in the 1990s ($\beta = 0.39$, p< 0.001) and 2000s ($\beta = 0.49$, p< 0.001), but not in countries with low GDP per capita ($- 1$ SD) (1990s: $\beta = 0.01$, p$= 0.93$; 2000s: $\beta = 0.12$, p$= 0.28$).

The indirect effect of GDP per capita between uncertainty avoidance and the percentage of older adults was not significant among females in the 1990s ($\beta = 0.06$, p$= 0.18$) or the 2000s ($\beta = 0.007$, p$= 0.18$).

Power distance was negatively associated with life expectancy among males in all three decades, but this did not reach statistical significance in the 2000s. When an interaction between uncertainty avoidance and GDP per capita was entered into the models, there were associations with life expectancy for both males ($\beta = 2.35$, p$= 0.039$) and females ($\beta = 2.39$, p$= 0.008$) in the 1990s. No interaction effects for other cultural values and GDP per capita showed significant associations.

The regression lines for the interaction effects of uncertainty avoidance and GDP per capita on life expectancy showed that, in the 1990s, there was a significant positive association for females in countries with high GDP per capita ($\beta = 0.31$, p$= 0.003$) but not for males ($\beta = 0.23$, p$= 0.082$). We observed negative associations in countries with low GDP per capita for males ($\beta = - 0.22$, p$= 0.16$) and females ($\beta = - 0.15$, p$= 0.23$) (Fig. 2). As time progressed, the interaction effects of uncertainty avoidance and GDP per capita on life expectancy became smaller. The mediation model for GDP per capita between uncertainty avoidance and life expectancy showed no significant indirect effect for either males or females in the 1990s (males: $\beta = 0.10$, p$= 0.082$; females: $\beta = 0.11$, p$= 0.067$).

The VIFs were low (< 3.0), suggesting there were no multicollinearity problems. The set of explanatory variables significantly explained the total fertility rate, and uncertainty avoidance was negatively associated with the total fertility rate in the 1990s (Table 3). When the interaction between uncertainty avoidance and GDP per capita was entered into the model, there was a significant association with the total fertility rate in the 1990s ($\beta = - 2.40$, p$= 0.021$). Associations in the 2000s and in 2010s did not reach statistical significance ($\beta = - 2.56$,p$= 0.056$ and $\beta = - 2.32$, p$= 0.14$, respectively).

Table 1 Results of multiple regression analyses to investigate associations between cultural values and percentage of older adults by gender
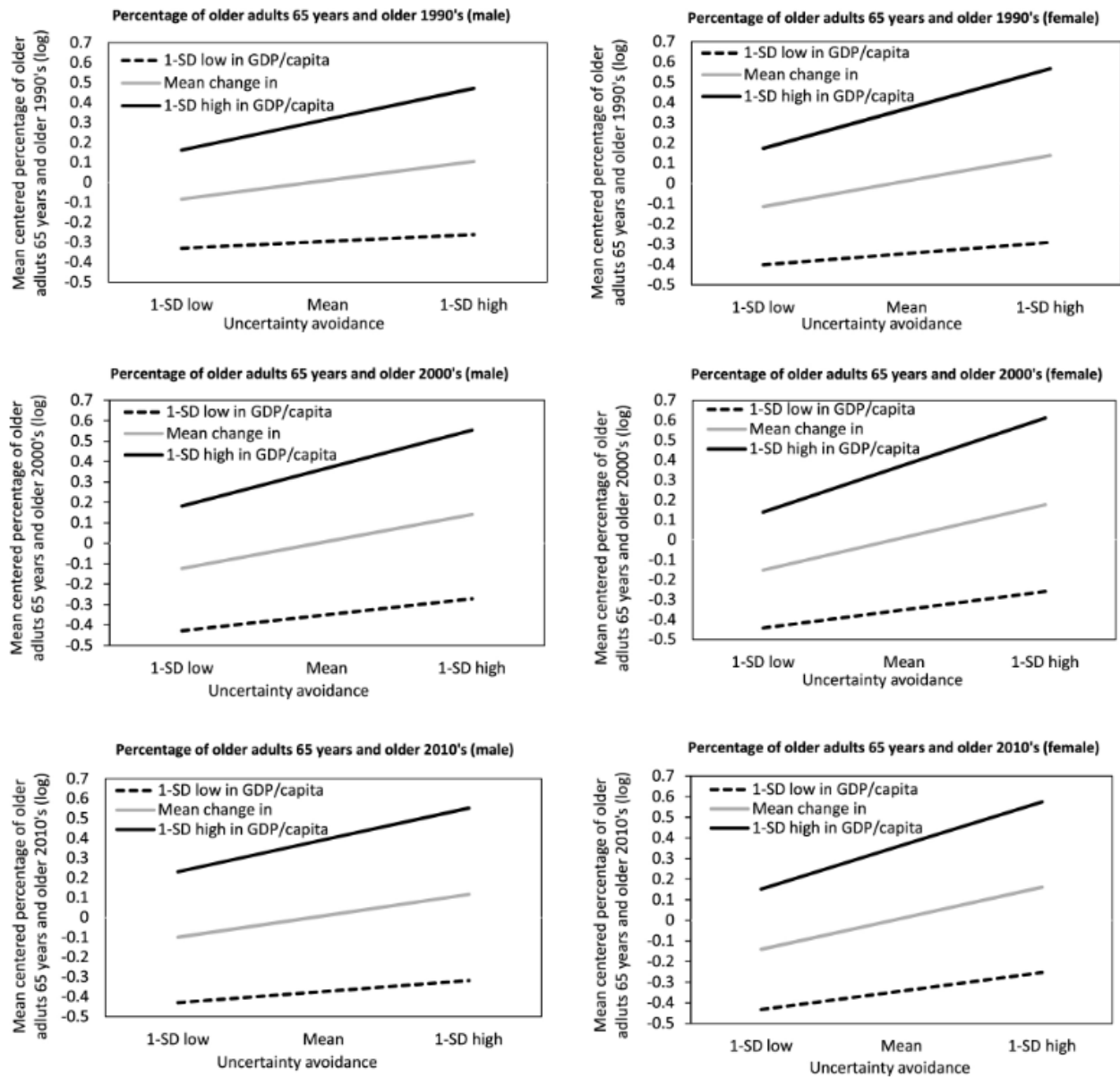
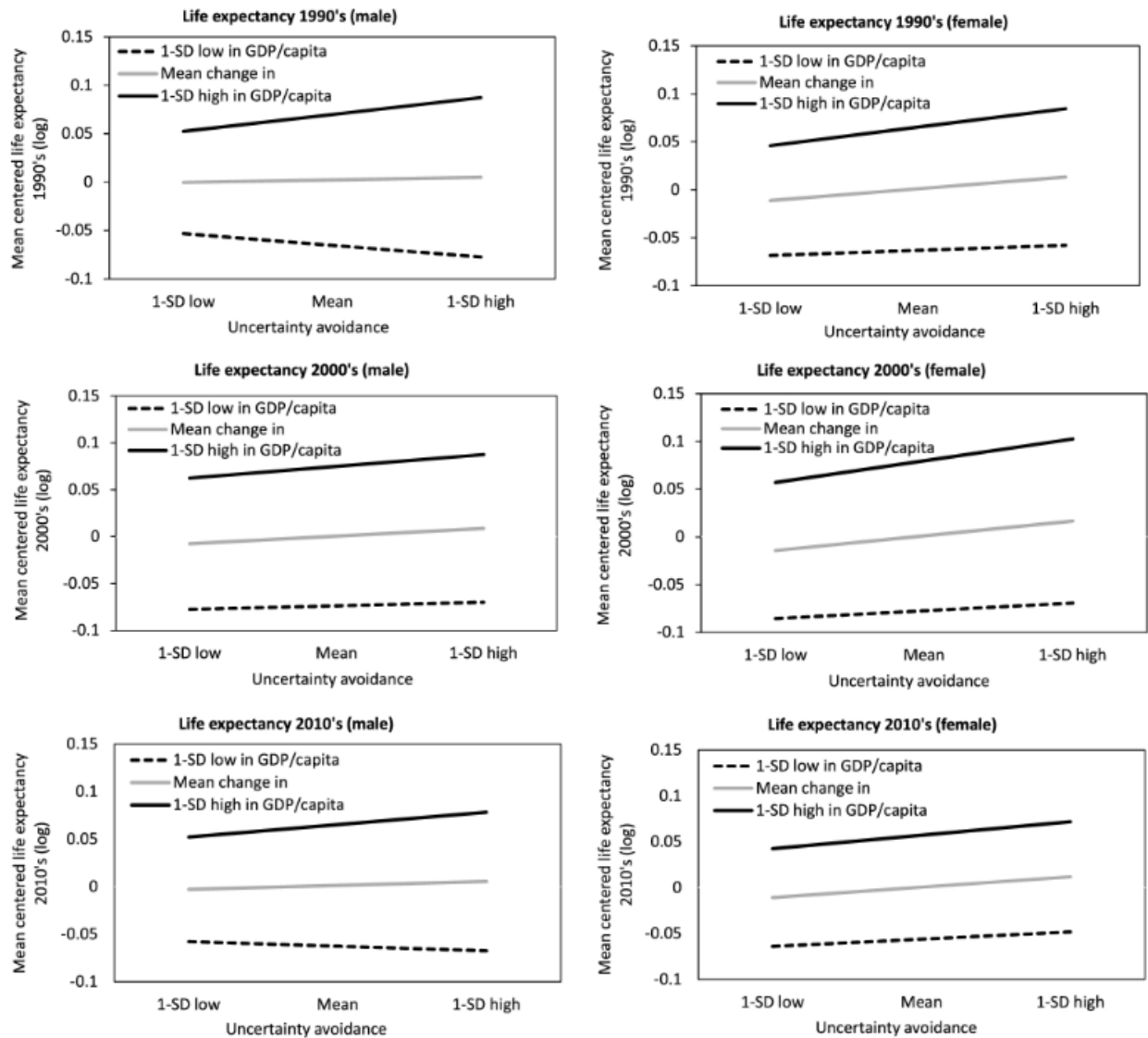|	**Male**											
	1990s				**2000s**				**2010s**			
	B	**SE**	**β**	**p**	**B**	**SE**	**β**	**p**	**B**	**SE**	**β**	**p**
Power distance	− 0.005	0.002	− 0.19	0.057	− 0.003	0.002	− 0.14	0.16	− 0.004	0.002	− 0.17	0.083
Individualism	0.006	0.002	0.29	0.011	0.004	0.002	0.19	0.10	0.002	0.002	0.10	0.35
Masculinity	− 0.002	0.002	− 0.06	0.38	0.000	0.002	− 0.017	0.82	0.000	0.002	− 0.002	0.97
Uncertainty avoidance	0.004	0.002	0.20	0.012	0.006	0.002	0.30	< 0.001	0.005	0.002	0.25	0.002
GDP per capita	0.24	0.064	0.43	< 0.001	0.30	0.059	0.56	< 0.001	0.32	0.061	0.58	< 0.001
Gender gap of educational attainment	0.28	0.18	0.14	0.13	0.42	0.17	0.23	0.015	0.31	0.17	0.17	0.076
Gender gap of labour force	− 0.47	0.12	− 0.33	< 0.001	− 0.54	0.11	− 0.40	< 0.001	− 0.55	0.12	− 0.40	< 0.001
F			21.42	< 0.001			21.59	< 0.001			21.62	< 0.001
R^2			0.75				0.75				0.75	
Adjusted R^2			0.71				0.71				0.71	
	Female											
	1990s				**2000s**				**2010s**			
	B	**SE**	**β**	**p**	**B**	**SE**	**β**	**p**	**B**	**SE**	**β**	**p**
Power distance	− 0.004	0.002	− 0.14	0.10	− 0.003	0.002	− 0.11	0.20	− 0.003	0.002	− 0.13	0.15
Individualism	0.007	0.002	0.29	0.003	0.005	0.002	0.21	0.034	0.003	0.002	0.14	0.18
Masculinity	− 0.002	0.002	− 0.045	0.46	− 0.001	0.002	− 0.021	0.74	0.000	0.002	− 0.009	0.89
Uncertainty avoidance	0.006	0.002	0.23	< 0.001	0.007	0.002	0.34	< 0.001	0.007	0.001	0.33	< 0.001
GDP per capita	0.32	0.063	0.47	< 0.001	0.31	0.058	0.52	< 0.001	0.30	0.057	0.52	< 0.001
Gender gap of educational attainment	0.31	0.18	0.13	0.090	0.38	0.16	0.18	0.026	0.26	0.16	0.13	0.11
Gender gap of labour force	− 0.67	0.12	− 0.41	< 0.001	− 0.70	0.11	− 0.47	< 0.001	− 0.70	0.11	− 0.49	< 0.001
F			33.32	< 0.001			30.14	< 0.001			28.46	< 0.001
R^2			0.82				0.81				0.80	
Adjusted R^2			0.80				0.78				0.77	

SE: Standard error

Table 2 Results of multiple regression analyses to investigate associations between cultural values and percentage of life expectancy by gender

Male

	1990s				2000s				2010s			
	B	**SE**	**β**	**p**	**B**	**SE**	**β**	**p**	**B**	**SE**	**β**	**p**
Power distance	−0.0009	0.0004	−0.27	0.027	−0.001	0.001	−0.28	0.061	−0.0009	0.0005	−0.29	0.046
Individualism	−0.0004	0.0004	−0.13	0.33	−0.001	0.001	−0.15	0.38	−0.000003	0.00046	−0.001	0.99
Masculinity	0.0001	0.0004	0.017	0.84	0.00004	0.001	0.007	0.95	−0.0001	0.0004	−0.033	0.75
Uncertainty avoidance	0.0001	0.0003	0.040	0.68	0.0002	0.0004	0.043	0.72	0.0001	0.0003	0.047	0.68
GDP per capita	0.046	0.011	0.55	<0.001	0.051	0.016	0.53	0.003	0.039	0.013	0.51	0.003
Gender gap of educational attainment	−0.052	0.031	−0.18	0.10	−0.016	0.044	−0.048	0.73	0.015	0.034	0.057	0.66
Gender gap of labour force	−0.029	0.021	−0.14	0.17	−0.020	0.029	−0.085	0.50	−0.017	0.023	−0.090	0.45
F			12.89	<0.001			6.00	<0.001			7.26	<0.001
R^2			0.64				0.46				0.50	
Adjusted R^2			0.59				0.38				0.43	

Female

	1990s				2000s				2010s			
	B	**SE**	**β**	**p**	**B**	**SE**	**β**	**p**	**B**	**SE**	**β**	**p**
Power distance	−0.0006	0.0004	−0.17	0.079	−0.0006	0.0006	−0.15	0.29	−0.0005	0.0004	−0.19	0.14
Individualism	−0.0004	0.0004	−0.11	0.30	−0.0006	0.0006	−0.16	0.30	−0.0003	0.0004	−0.14	0.35
Masculinity	0.0000	0.0003	0.000	1.00	−0.0001	0.0005	−0.012	0.90	−0.0001	0.0003	−0.033	0.72
Uncertainty avoidance	0.0004	0.0003	0.12	0.13	0.0005	0.0004	0.14	0.20	0.0004	0.0003	0.16	0.13
GDP per capita	0.052	0.010	0.57	<0.001	0.059	0.015	0.61	<0.001	0.039	0.010	0.59	<0.001
Gender gap of educational attainment	−0.078	0.027	−0.25	0.006	−0.043	0.042	−0.13	0.31	−0.019	0.027	−0.083	0.49
Gender gap of labour force	−0.057	0.018	−0.25	0.003	−0.030	0.028	−0.13	0.28	−0.035	0.018	−0.22	0.053
F			24.04	<0.001			8.10	<0.001			10.01	<0.001
R^2			0.77				0.53				0.58	
Adjusted R^2			0.74				0.47				0.53	

SE: Standard error

Regression lines and predicted values illustrate the interactive effects of uncertainty avoidance and gross domestic product per capita on the mean-centered percentages of older adults aged 65 and older by males and females in the 1990s, 2000s, and 2010s. Footnote: Regression lines constructed from intercepts, unstandardized regression coefficients, mean values, and standard deviations (SD). Scores were plotted at the mean, 1 SD below the mean (1-SD reduction) and 1 SD above the mean (1-SD increase)
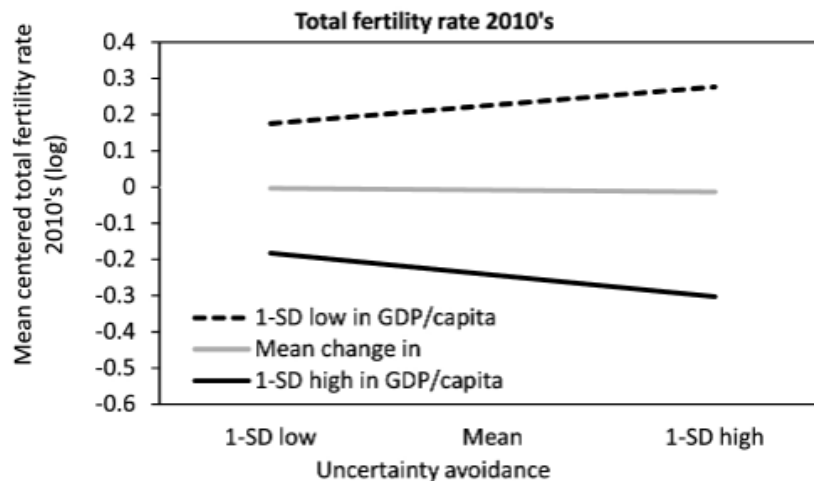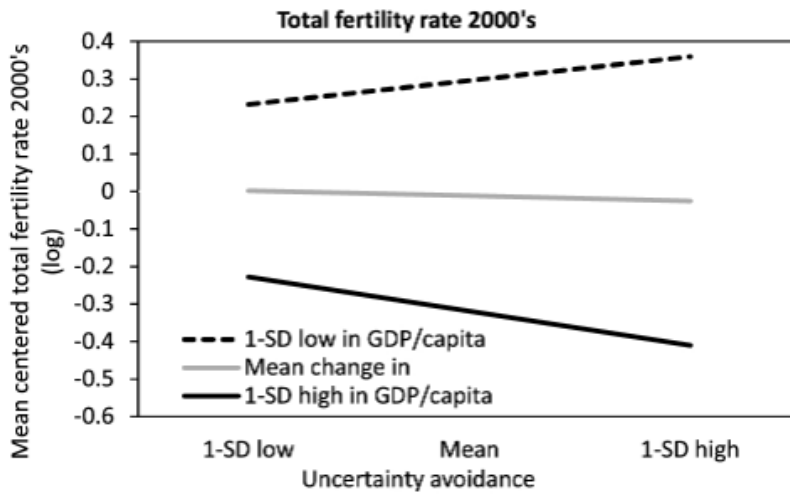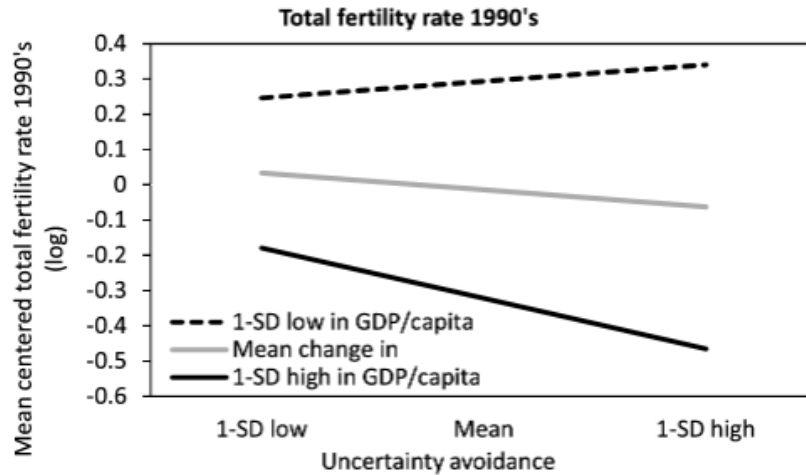
Regression lines and predicted values illustrate the interactive effects of uncertainty avoidance and gross domestic product per capita on mean-centered life expectancy by males and females in the 1990s, 2000s, and 2010s. Footnote: Regression lines constructed from intercepts, unstandardized regression coefficients, mean values, and standard deviations (SD). Scores were plotted at the mean, 1 SD below the mean (1-SD reduction) and 1 SD above the mean (1-SD increase)

Table 3 Results of multiple regression analyses of associations between cultural values and total fertility rate

	Female											
	1990s				2000s				2010s			
	B	**SE**	**β**	**p**	**B**	**SE**	**β**	**p**	**B**	**SE**	**β**	**p**
Power distance	− 0.0004	0.002	− 0.022	0.84	− 0.0002	0.002	− 0.016	0.91	− 0.0002	0.002	− 0.018	0.91
Individualism	0.001	0.002	0.044	0.72	0.001	0.002	0.11	0.48	0.002	0.002	0.25	0.19
Masculinity	− 0.002	0.002	− 0.10	0.21	− 0.002	0.002	− 0.11	0.27	− 0.001	0.002	− 0.057	0.63
Uncertainty avoidance	− 0.003	0.001	− 0.18	0.041	− 0.002	0.001	− 0.15	0.19	− 0.001	0.001	− 0.10	0.44
GDP per capita	− 0.28	0.053	− 0.68	< 0.001	− 0.24	0.058	− 0.68	< 0.001	− 0.17	0.050	− 0.64	0.002
Gender gap of educational attainment	− 0.25	0.14	− 0.18	0.076	− 0.28	0.15	− 0.24	0.075	− 0.19	0.13	− 0.21	0.17
Gender gap of labour force	0.57	0.094	0.56	< 0.001	0.42	0.10	0.48	< 0.001	0.27	0.089	0.42	0.004
F			17.69	< 0.001			7.84	< 0.001			3.78	0.002
R^2			0.72				0.53				0.36	
Adjusted R^2			0.68				0.47				0.26	

SE: Standard error

Total fertility rate 1990's

Total fertility rate 2000's

Total fertility rate 2010's

Regression lines and predicted values illustrate the interactive effects of uncertainty avoidance and gross domestic product per capita on mean-centered total fertility rate in the 1990s, 2000s, and 2010s. Footnote: Regression lines constructed from intercepts, unstandardized regression coefficients, mean values, and standard deviations (SD). Scores were plotted at the mean, 1 SD below the mean (1-SD reduction) and 1 SD above the mean (1-SD increase)

The regression lines for the interaction effects of uncertainty avoidance and GDP per capita on the total fertility rate showed opposite trends. The positive association between uncertainty avoidance and total fertility rate was not significant in countries with low GDP per capita in the 1990s ($\beta = 0.09$, $p = 0.54$), whereas there was a significant negative association in countries with high GDP per capita ($\beta = -0.36$, $p = 0.002$) (Fig. 3). The mediation model for GDP per capita between uncertainty avoidance and total fertility rate showed no significant indirect effect (1990s: $\beta = -0.13$, $p = 0.066$; 2000s: $\beta = -0.13$, $p = 0.080$; 2010s: $\beta = 0.12$, $p = 0.099$).

Discussion

The present study investigated associations between Hofstede's four cultural values (i.e., power distance, individualism, masculinity, and uncertainty avoidance) and societal aging indicators, including the percentage of older adults, life expectancy, and total fertility rate. Individualism was positively associated with the percentage of older adults, especially in the 1990s, whereas power distance was negatively associated with male life expectancy in the 1990s and 2010s. Uncertainty avoidance was also positively associated with the percentage of older adults in all three decades for both males and females. Furthermore, the positive association between uncertainty avoidance and the percentage of older adults was significant, and life expectancy increased following an increase in uncertainty avoidance in countries with high GDP per capita but decreased following an increase in uncertainty avoidance in countries with low GDP per capita. An opposite trend was indicated for the total fertility rate. Uncertainty avoidance and GDP, as an indicator of economic activity, may therefore be key cultural values for aging societies.

The present study tested the association between GDP and longevity. It is known that countries with higher GDP have high life expectancy rates (World Bank, 2015a, 2015b). Several previous studies revealed that countries with higher GDP devoted larger amounts of expenditure to healthcare relative to population size (Voda & Bostan, 2018) and had more efficient drug surveillance and better healthcare systems (Lee et al., 2015) compared with countries with lower GDP. National wealth facilitates well-established healthcare systems, which would lead to increased longevity. Healthcare evaluations were affected by country-level factors, including physician density, total health expenditure, and Hofstede's power distance, but not by individual-level factors (Borisova et al., 2017). Stronger anti-hierarchical and egalitarian cultures also tend to evaluate healthcare services more positively. In the present study, power distance was negatively associated with male life expectancy in the 1990s and 2010s. Inequality in society may therefore have an effect on health, especially for males.

Previous studies showed individualism was positively associated with national wealth (Hofstede, 2001; Steel & Taras, 2010). Those studies tested whether individualism was associated with longer life expectancy, lower fertility rate, and a higher percentage of older adults in more recent decades. In the present study, individualism was associated with the percentages of older adults in the present study. As countries become economically developed, they shift toward greater individualism, even though cultural differences remain sizable (Santos et al., 2017). Accordingly, individualism is increased by generations (Taras et al., 2012). As countries become economically developed and shift toward greater individualism, people's mindsets and behaviors may change. Individualism was also strongly and positively associated with well-being (Fischer & Boer, 2011; Steel et al., 2018), which may have an effect on health (Okely et al., 2017). In the present study, Hofstede's cultural values were significantly associated with the outcome variables of the closest measurement point in the present study. Cultural values gradually change over generations (Taras

et al., 2012), and Hofstede's fundamental cultural values may not be predictive of longevity and birth rate in more recent decades. There may also be many potential confounding factors that affect associations between cultural values and longevity. However, the present study did not consider psychological factors such as well-being. Further studies are necessary to consider the impact of psychological factors on longevity.

Based on a previous study (Gaygisiz, 2009), we tested whether higher uncertainty avoidance was associated with shorter longevity in more recent decades. Notably, uncertainty avoidance was positively associated with the percentage of older adults in this study, especially during the early decades (i.e., the 1990s and 2000s). Gaygisiz (2009) suggested that the high mortality rate from traffic accidents in countries with high uncertainty avoidance may be because uncertainty avoidance leads to high stress, emotionality, and feelings of urgency, which in turn results in higher speeds and lower traffic safety. Uncertainty avoidance is related to feeling uncomfortable in unstructured situations (e.g., situations that are novel, unknown, surprising, or different from usual) (Hofstede, 2001). It has been noted that uncertainty avoidance is associated with mental health, including anxiety and depression (Bailey & Kind, 2010; Hofstede, 2001). Various factors may reduce uncertainty in the environments of countries with higher uncertainty avoidance that help people cope with anxiety (Bailey & Kind, 2010). For example, in high uncertainty avoidance countries, people may visit a medical doctor when they are anxious about their health status. "Health anxiety," which is defined as concern about health in an individual without pathology or excessive concern in an individual with some degree of pathology, may therefore affect health-seeking behavior, such as visiting medical doctors, collecting medical information, and obtaining medical knowledge (Eastin & Guinsler, 2006). Individuals with moderate and high levels of anxiety seek higher amounts of online health information and tend to make more medical appointments (Eastin & Guinsler, 2006). We cannot clearly explain why country-level uncertainty avoidance was predictive of longevity. However, country-level uncertainty avoidance may affect health-seeking behaviors and health outcomes at the individual level, which are linked to longevity. This tendency was significant in countries with higher GDP.

We also tested whether higher uncertainty avoidance was associated with a lower birth rate. In the present study, uncertainty avoidance was negatively associated with the total fertility rate. Women who are anxious about the future (including child-rearing costs and work/career) may avoid having a child. Based on a review of recent trends of decreasing fertility rates in Asian countries, there are four hypothetical reasons: falling employment among younger ages, popularization of higher education among younger ages, and career choices among younger women (Matsuda, 2017). Because economic development has been facilitated in Asian countries, insecure employment (e.g., irregular employment) may lead to anxiety about the future (Matsuda, 2017). The popularization of higher education has also increased the burden of education costs. Higher education for women is related to decreasing fertility rates in Asian countries, because women focus on work and their careers, and delay marriage and child-rearing. Support systems for child-rearing for working mothers are related to political decisions. In terms of decision-making processes, countries with high uncertainty avoidance appeared to take longer before agreeing or deciding on matters (Lisø, 2011). High uncertainty avoidance countries may therefore take longer to formulate effective policies for parenting support. Furthermore, women in countries with higher GDP and higher uncertainty avoidance showed decreased childbirth rates.

In addition, we tested whether GDP moderated or mediated the associations among cultural values, longevity and birth rate. Several studies investigated economic indices to explore interactions between cultural values and GDP, including national corruption (Gaygisiz & Lajunen,

2022) and entrepreneurial activity (Hancıoğlu et al., 2014). Given the moderating effect of GDP, countries with lower GDP showed a significant negative association between individualism and corruption (Gaygisiz & Lajunen, 2022). Conversely, countries with higher GDP and large populations showed a significant negative association between uncertainty avoidance and entrepreneurial activity (Hancıoğlu et al., 2014). In the present study, GDP had a significant moderating effect, but did not mediate the associations between uncertainty avoidance and outcome variables. Population aging may be brought about by a country's cultural values as well as vigorous economic activity.

Several limitations of this study should be discussed. This study used an ecological design; therefore, associations between cultural values and longevity at national levels cannot be applied to individual-level associations. Because we used Hofstede's cultural values, the countries were limited to those where IBM had regional offices in the 1970s. Estimated scores were used for 13 countries that were not included in the IBM dataset, including Russia and China. African countries were also limited. When we excluded countries with estimated scores from the analyses, uncertainty avoidance was significantly associated with longevity indices and total fertility rate (data not shown). Although it has been assumed that cultural change would be extremely slow, Hofstede's cultural values showed stronger associations with longevity and childbirth indices in earlier decades. The stability of cultural values has been noted as a contributing problem (Baskervill, 2003). Using panel data from Taras et al. (2012), comparisons of cultural value scores between the 1990s and 2000s showed significant reductions in power distance, masculinity, and uncertainty avoidance, but a significant increase in individualism (data not shown and were not used in the present study because of the limited number of countries). Cultural change should also be considered to predict the future status of the aging society. In this study, we focused on Hofstede's four cultural values, and did not consider other cultural values. Further studies could also consider Hofstede's two additional dimensions (i.e., short-term-long-term orientation and indulgence), because these factors have been investigated in relation to prosocial behavior (Guo et al., 2018) and happiness (Rajkumar, 2023). Finally, we considered GDP per capita and gender differences in higher educational attainment and labor force participation rates. Multiple factors could affect longevity and childbirth, and there may be other possible confounding factors that need to be considered in further studies.

In conclusion, among Hofstede's four fundamental dimensions, uncertainty avoidance was positively associated with longer life expectancy and a higher percentage of older adults, and negatively associated with a higher fertility rate. Furthermore, GDP moderated the associations between uncertainty avoidance and aging society indices, meaning the effect was significant in countries with higher GDP but not in countries with lower GDP. Associations between uncertainty avoidance and aging society indices were significant in the 1990s when Hofstede's cultural values were surveyed, and those cultural values may be gradually changing. Further studies, including longitudinal panel analyses, are necessary to clarify the effects of cultural values on aging societies.

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