The Pattern of Mortality Convergence in Older Ages

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Abstract

According to the selective survival theory, as persons enter old age, the mortality inequality decreases the effect of sociodemographic factors due to inherited genetic characteristics. This study examines how different convergence patterns appear due to sociodemographic factors by dividing them into four groups consisting of ascribed sociodemographic factors, endogenous factors, social contextual factors and environmental factors to investigate the variety of convergence pattern. We suspect that as a person ages, first the determinations and coefficients of social factors decrease, second, ascribed sociodemographic factor decreases the most, and third, exogenous factor converges the least. We employ the data set of the National Longitudinal Survey (NLS) older men as the main source of information. Our results provide a definitive pattern of variable differentials declining as an individual ages, but the rate at which they do so is conditional on the nature of each variable.

Introduction

Research has shown that the effects of socioeconomic status (SES) play large roles in US populations as they enter older age, resulting in a divergence of SES and health; conversely, a smaller function in a person's health is determinate on SES as he or she enters old age and in fact SES converges. It is known that SES is significantly correlated with morbidity and mortality inversely; meaning, populations that have lower SES, commonly have higher rates of mortality and morbidity.

It is generally expressed that the convergence of SES differentiation appears in old age principally grounded by selective survival theory or heterogeneity hypothesis in demographic explanation. According to these views, because the strong correlation between mortality and sociodemographics in younger age causes disadvantaged and fragile people to die more frequently before reaching old age. Consequently, those who survive past younger age are healthier and tend to live longer. Thus the inequality of mortality among one's health may converge with age.

Though these views are substantiated with a number of empirical studies, it seems that the explanation about what selective survival is depended on biological issues, leaving several questions unexplained in demographic studies. First, how does selective survival relate with sociodemographic variables? Second, in what patterns does SES converge? Third, what affect do sociodemographic variables on mortality and health status of the elderly decrease by age? Fourth, how much do sociodemographics explain mortality and health status in old age? The purpose of this paper is to examine the effects of sociodemographic factors on mortality in old age, and understand the pathways by which they operate. It is expected to contribute to the discussion of mortality in old age,

for instance the controversy on rectangularization. We consider the pattern of mortality convergence may be different by the characteristics of the variables and ages.

Literature Review

Sociodemographic factors are known to decrease as one ages in the U.S. (von dem Knesebeck et al. 2003; House et al. 1994). Selective survival theory explains that SES inequality in health diminishes because selected survival of healthy people converge the difference of health risks and protections in very old age (House et al. 1994; von dem Knesebeck et al. 2003). This idea is consistent with a number of research findings on the pattern of mortality in very old age. They propose due to selective survival that mortality convergence at older ages, causes deceleration in the age pattern of mortality (Horiuchi and Wilmoth 1997; Maton, Stallard, and Corder, 1997; Perls, 1995). Though these researchers show the converging mortality pattern, they don't explain what causes selective survival, leaving biological and physiological research to provide the explanations (Edwards 2004; Hui et al.1987).

However, some studies, based on cumulative advantage theory, propose that various health statuses are affected by higher attainments of education increases as aging occurs (Ross and Wu 1996; Lauderale, 2001). According to this view, the divergence of mortality and education inequality results because education and career achievement causes disparity of income and occupation increases in old ages. This indirectly shows that sociodemographic factors have an influence on mortality in old age. The difference between the two views isn't due to disagreement on the attitude toward the effects of sociodemographic variables on mortality, but may differentiate because the former

emphasizes the effect of inherited biological genetic factors and the latter focuses on sociodemographic factors.

According to literature, the factors on mortality and convergence in old age are associated with biological and sociodemographic factors. However, currently research is investigating the affects of SES only in traditional areas that are limited (i.e. sex, race/ethnicity, income, and education) (Maddox and Clark, 1992; Mackillop et al. 2000; Ross and Wu, 1996).

Though these basic demographic variables have been continually investigated, their affects are still not completely understood. The most basic of these is race. Currently from the moment of birth, a white infant has 5.6 years life expectancy advantage over blacks (Minino and Smith, 2001). Differences in ethnicity and race engage in crucial impacts of infant mortality, because infants born to black women suffer the highest infant mortality risks (Hummer et al. 1999a).

In 1920, in the United States, differentials in a higher male mortality existed (a 1.8 year favor); by 1970, the gap widened by nearly eight years (Knudsen and McNown, 1993). This advantage has since fallen and hovered to about eight years since due largely to men's behavioral (e.g., smoking and dietary) and hormonal factors (Nathanson, 1984).

Income is a staple component of SES. Because of the many facets that income creates, some researchers have begun new approaches to their investigation of SES by using measures of assets and home ownership. These are believed to be greater indicators of assessing accumulated advantage or disadvantage as the case may be as they more closely represent economic disparities (Oliver and Shapiro, 1995; Robert and House 1996; von dem Knesebeck et al. 2003). However, it is important to note that African

Americans in similar income brackets as whites are less likely to own a home (Collins and Robert, 2001) and that the disadvantageous asset holdings affect their mortality rates differently (Bond Huie et al. 2003).

Education is closely related to income and is found to be a leading indicator associated with function of health (Berkman and Gurland, 1998; Christensen and Johnson,1995). Controlling for sex, those with elevated levels of education could anticipate to live longer both in years and without limitation (Molla et al. 2004). Some argue that it may be the chief variable of importance in predicting mortality (Liberatos, 1988) as it is the source by which income, occupation, and residence.

One area that hasn't been as closely examined in older age SES is the affects of religion. Hummer and colleagues (1999b) found higher mortality in those who never attend religious activities compared to those that attend weekly. Involvement in a religious community is theorized to give not only physical benefits i.e. reduction of cancer rates (Dwyer et al. 1990), but also provide psychological advantages (Kark et al. 1996).

One's position of marital status has a direct influence on their risk of mortality. After marriage men are found to profit immediately from a lesser mortality and better mental health (Lillard and Waite, 1995). However, men that were recently widowed are inclined to have higher death rates than those that have never married or remarried (Helsing et al. 1981). In addition, those that have been divorced also have a greater propensity for increased mortality risk (Zick and Smith, 1991).

Though individual-level and family-level variables provide more powerful predictions, it has been suggested that the community-level SES and social contextual

factors are examined as they provide a uniquely insightful dimension of mortality (Anderson et al. 1997; Robert, 1998). For example, low SES neighborhoods more commonly experience environments that lack adequate public health services, while maintaining higher levels of pollution and crime. These features are powerful predictors of poor health to an individual (Robert, 1999; Macintyre et al., 1993). Likewise, they provide considerable influence on one's perception quality of neighborhood characteristics, which, consequently affect their physical and emotional health (Cho et al. 2004). Hayward and colleagues (1997) found one characteristic of rural areas that is not a function of the distribution of individual-level risk factors across residential type is longer life for men compared to their urban counterpart. In addition, they observed the length of rural men's lives as being less sensitive to both social origin and economic resources in later life periods, appearing that rural men's mortality advantages agree, and thus, have a less central role of social differentiation as a determinant of mortality.

Conceptualization of Convergence

As a person ages, their psychological and physical responses may change how and to what extreme an individual responds to various endogenous and exogenous factors that result in differing consequences to their state of being. We attempt to map the corridors by which SES leads to inequalities of mortality in early years, and congregate in old age by offering an exploratory model that dissects SES into manageable parts and measure what factors converge and diverge first. Thus, a new understanding will be given of what factors will play the most important and least important indicator types of socioeconomic status given from the concenter.

Sociodemographic factors can be divided dependent on constancy and internality, and grouped into 'ascribed factors' and 'achieved factors'. An ascribed factor is usually fixed and is a inherited biological factor such as sex and race. Still an achieved factor is commonly defined as something a person can be accredited for by one's experiences, but can be divided more intricately into two kinds of factor: 'endogenous factor' and 'exogenous factor.' Endogenous factors are those that result from individual characteristics within the individual limits of a person. Conversely, exogenous factors are contextually sociological or environmental based and affect the person from the exterior.

This study will use both ascribed and achieved sociodemographic as variables to discover what roles these types of variables have on the convergence process as individuals age. However, biological variables among the factors on mortality are excluded in the population study. As moving from ascribed sociodemographic factor to exogenous factors, the affinity between biologically inherited and sociodemographic factors will become obscure in terms of constancy and individuality of the characteristics.

The division of factors is summarized in Figure 1.

Methods

Data

The survey for National Longitudinal Survey (NLS) older men, born between 1907 and 1921, is employed as a source of data, which, includes 5,020 nationally representative samples. This survey, began in 1966, includes the information about not only sociodemographic characteristics but also death. Though the cohort survey ceased in 1981, information was collected from respondents, widows or other next-of-kin deceased respondents in 1990. Since this current study targets only on people older than 55years in

1971 and 65 years in 1981 whose health limitation and death information is available or who survived in 1990, a subset of 2,606 respondents are utilized here. Analysis will be conducted separately by age group and year. Differences of the effects of independent valuables will be examined (multi-cross sectional analysis). We tracked sociodemographic factors in an age cohort group between two time points.

The Age cohort analysis model is summarized in Figure 2.

Measurement

Dependent variable: Death or Survival in 5 years and Health limitation

Independent variable:

In this study, independent variables are categorized into 'Ascribed Sociodemographic Factor', 'Endogenous Factor', 'Social Contextual Factor', and 'Environmental Factor'.

Ascribed Sociodemographic Factor: Race/ ethnicity
Endogenous Factor: SES
Social Contextual Factor: Marital Status
Environmental Factor: Residence Place

Hypothesis

- As one gets old, the determinations and coefficients of social factors decrease.
- Ascribed sociodemographic factor decreases the least with age.
- Exogenous factor converges the most with age.

Results

The purpose of this study is to examine sociodemographic factors and the pattern by which they converge. We focused on the changes of odd ratios between two time points (1971 and 1981) using findings on mortality to show the different converging patterns by

variables. The results of the variables in the 1981 survey failed to present statistical significance. This seems due to a small sample size developed from missing cases which don't include death information. Nevertheless, the results generally supported the hypothesis of sociodemographic variables converging.

Race was used to vicariously represent ascribed sociodemographic factors and continues the aforementioned patterned effects of convergence between 1971 and 1981. The results indicate that black people are less likely to survive than white people at older ages. Though the effect of "other race" declines, it has little statistical meaning because the sample size is very small (n = 44). For endogenous factors including SES variables, the effects declined more compared with the change of race effect except the influence of asset; concluding that the factor of SES on mortality of the elderly becomes less important at older ages.

The effects of marital status presenting social contextual achieved factors odds ratio decreases more than any other factors. Without controlling for age effects, the effect inclined. After being controlled for, the effect declined, concluding that the effect of the duration effect of being not married is controlled, considering that persons are more likely to lose a spouse as they age. Finally, the pattern of a change in residence place meaning social contextual achieved factor depicted a different pattern from our hypothesis. Our results resolved that the positive effects of rural residence continue its advantages compared with its counterpart urban residence, and that the pattern was less changed than the other factors. Our findings supported previous studies that rural area residence during a person's periods of inactivity. Likewise, it also supports that the environmental effects on mortality need to be more importantly considered at older ages.

Using health limitation as dependent variables, our results show that more variables are significant than the previous analysis support our hypothesis and thus the results of the mortality model. The effect of being black in contrast with being white is occurring even at older age at the statistically significant level show less convergence in the ascribed sociodemographic factors. For the endogenous factor presented by SES variables in this study, the effect declined more than race factors. The effects of education at older age (in 1981) showed opposite influence in 1971. This means that factors in education lose its power of influence at older age after controlling other SES factors. The convergences in income variables appear through most groups. The effect of asset at older age was not significant in this study. The convergence pattern of the effects of residence place appears in similar way with the analysis on mortality. The old people in rural areas were less likely to have health limitation than in urban and suburban areas. The results showed an increase in the differentials and emphasized the magnitude of environmental effects at older ages. These results can be summarized simply that all variable differentials decline in a similar pattern as an individual ages, but the degree or rate decline is pendent on each variable.

Discussion

This study examined the pattern of the convergences of mortality and health status in older ages analyzing longitudinal and multivariable data. Though a lot of previous studies dealt with it, they were based on cross sectional data focusing only on a small number of variables such as education and sex. For the investigation we categorized sociodemographic factors into four groups consisting of ascribed sociodemographic

factor, endogenous factor, social contextual factor and environmental factor based on selective survival theory.

We hypothesized that as a person ages, first the determinations and coefficients of social factors decrease, second, ascribed sociodemographic factor decreases the most, and third, exogenous factor converges the least. The general findings supported our hypothesis but environmental factor narrated by residence place has comparatively constant effects even at older age or among inactive persons. To summarize, these results demonstrate that each of the variable differentials decline as an individual ages, but the rate of decline at which they do so is conditional on the nature of each variable.

Several limitations of this study should be mentioned. First, it has limitation to examine the mortality at very old ages over 75 years old. The convergences of mortality and health status in very older ages can be different i.e. the crossover effect in the mortality rate for blacks and whites at very old ages. Second, the sample size is relatively small for the study on mortality. A two-sided approach controlling both cohort effects and period effects is necessary to examine the convergences of mortality and health status. This problem of small sample size limited the researchers to investigate in a cross sectional pattern. Despite of these limitations, the study has some implications such as longitudinal approach and categorization of sociodemographic factors. It is hoped that this study will stimulate further research in this field.

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Appendix

Figure 1. The division of factors

<table>
<tr><td rowspan="2">Ascribed Factor</td><td colspan="2">Biological Factor</td><td>Inherited Genetic Characteristics</td></tr>
<tr><td colspan="2">Ascribed Sociodemographic Factor</td><td>Sex; Race/ Ethnicity</td></tr>
<tr><td rowspan="3">Achieved Factor</td><td colspan="2">Endogenous Factor</td><td>SES; Behavior</td></tr>
<tr><td rowspan="2">Exogenous Factor</td><td>Social Contextual</td><td>Marital Status;
Neighborhood Effect</td></tr>
<tr><td>Environmental</td><td>Residence Place (e.g. rural, urban);
Geographical Characteristics
(e.g. mountain, coast)</td></tr>
</table>

Figure 2. Analysis Model

Year	1971	1981
Age	55~64	65~74

Table 1. Distribution of Sample Characteristics in 1971 by Dependent Variable

	Survival	Death	Total
Race			
Back	626 (84.0)	119 (16.0)	745 (100.0)
Other	39 (88.6)	5 (11.4)	44 (100.0)
White	1,631 (89.5)	192 (10.5)	1823 (100.0)
Education			
0-8 years	1,056 (85.9)	174 (14.1)	1,230 (100.0)
9-11 years	899 (89.4)	107 (10.6)	1,006 (100.0)
12+ years	332 (91.5)	31 (8.5)	363 (100.0)
Income			
Bottom 25%	428 (86.6)	66 (13.4)	494 (100.0)
Low 25%	442 (90.0)	49 (10.0)	491 (100.0)
High 25%	459 (93.3)	33 (6.7)	492 (100.0)
Highest 25%	570 (88.8)	72 (11.2)	642 (100.0)
Missing	397 (80.5)	96 (19.5)	493 (100.0)
Asset			
No Assets	208 (82.5)	44 (17.5)	252 (100.0)
Assets	1,459 (88.1)	198 (11.9)	1,657 (100.0)
Missing	629 (89.5)	74 (10.5)	703 (100.0)
Marital Status			
Married	2,201 (87.9)	303 (12.1)	2,504 (100.0)
Non-married	95 (88.0)	13 (12.0)	108 (100.0)
Residence place			
Urban	795 (84.2)	149 (15.8)	944 (100.0)
Suburban	751 (92.1)	64 (7.9)	815 (100.0)
Rural	750 (87.9)	103 (12.1)	853 (100.0)
Health Limitation			
Non-Limitation	1,615 (93.0)	122 (7.0)	1,737 (100.0)
Limitation	681 (77.8)	194 (22.2)	875 (100.0)
Age			
	1,295 (88.9)	162 (11.1)	1,457 (100.0)
	1,001 (86.7)	154 (13.3)	1,155 (100.0)

Table 2. Distribution of Sample Characteristics in 1981 by Dependent Variable

	Survival	Death	Total
Race			
Back	199 (84.3)	37 (15.7)	236 (100.0)
Other	14 (82.4)	3 (17.6)	17 (100.0)
White	724(89.1)	89 (10.9)	813 (100.0)
Education			
0-8 years	347 (85.3)	60 (14.7)	407 (100.0)
9-11 years	407 (89.5)	48 (10.5)	455 (100.0)
12+ years	180 (89.6)	21 (10.4)	201 (100.0)
Income			
Bottom 25%	100 (88.5)	13 (11.5)	113 (100.0)
Low 25%	134 (83.8)	26 (16.3)	160 (100.0)
High 25%	169 (86.2)	27 (13.8)	196 (100.0)
Highest 25%	195 (89.9)	22 (10.1)	217 (100.0)
Missing	339 (89.2)	41 (10.8)	380 (100.0)
Asset			
No Assets	48 (73.8)	17 (26.2)	65 (100.0)
Assets	614 (88.1)	83 (11.9)	697 (100.0)
Missing	275 (90.5)	29 (9.5)	304 (100.0)
Marital Status			
Married	771 (88.7)	98 (11.3)	869 (100.0)
Non-married	166 (84.3)	31 (15.7)	197 (100.0)
Residence place			
Urban	267 (84.5)	49 (15.5)	316 (100.0)
Suburban	324 (90.0)	36 (10.0)	360 (100.0)
Rural	346 (88.7)	44 (11.3)	390 (100.0)
Health Limitation			
Non-Limitation	580 (89.4)	69 (10.6)	649 (100.0)
Limitation	357 (85.6)	60 (14.4)	417 (100.0)
Age			
	576 (90.6)	60 (9.4)	636 (100.0)
	361 (84.0)	69 (16.0)	430 (100.0)

Table 3. Distribution of Sample Characteristics in 1971 by Dependent Variable

	Non-Limitation	Limitation	Total
Race			
Back	479 (64.0)	269 (36.0)	748 (100.0)
Other	30 (68.2)	14 (31.8)	44 (100.0)
White	1,233 (67.5)	594 (32.5)	1,827 (100.0)
Education			
0-8 years	746 (60.5)	488 (39.5)	1,234 (100.0)
9-11 years	718 (71.3)	289 (28.7)	1,007 (100.0)
12+ years	273 (74.8)	92 (25.2)	365 (100.0)
Income			
Bottom 25%	208 (42.1)	286 (57.9)	494 (100.0)
Low 25%	331 (66.9)	164 (33.1)	495 (100.0)
High 25%	373 (75.7)	120 (24.3)	493 (100.0)
Highest 25%	403 (81.7)	90 (18.3)	493 (100.0)
Missing	427 (66.3)	217 (33.7)	644 (100.0)
Asset			
No Assets	132 (52.0)	122 (48.0)	254 (100.0)
Assets	1,129 (68.0)	531 (32.0)	1660 (100.0)
Missing	481 (68.2)	224 (31.8)	705 (100.0)
Marital Status			
Married	1,676 (66.7)	835 (33.3)	2,511 (100.0)
Non-married	66 (61.1)	42 (38.9)	108 (100.0)
Residence place			
Urban	656 (69.1)	293 (30.9)	949 (100.0)
Suburban	576 (70.5)	241 (29.5)	817 (100.0)
Rural	510 (59.8)	343 (40.2)	853 (100.0)
Age			
	1,050 (71.9)	411 (28.1)	1,461 (100.0)
	692 (59.8)	466 (40.2)	1,158 (100.0)

Table 4. Distribution of Sample Characteristics in 1981 by Dependent Variable

	Survival	Death	Total
Race			
Back	166 (63.1)	97 (36.9)	263 (100.0)
Other	15 (75.0)	5 (25.0)	20 (100.0)
White	521 (59.3)	357 (40.7)	878 (100.0)
Education			
0-8 years	263 (59.2)	181 (40.8)	444 (100.0)
9-11 years	303 (61.7)	188 (38.3)	491 (100.0)
12+ years	134 (60.1)	89 (39.9)	223 (100.0)
Income			
Bottom 25%	55 (44.4)	69 (55.6)	124 (100.0)
Low 25%	96 (54.2)	81 (45.8)	177 (100.0)
High 25%	121 (59.0)	84 (41.0)	205 (100.0)
Highest 25%	155 (66.8)	77 (33.2)	232 (100.0)
Missing	275 (65.0)	148 (35.0)	423 (100.0)
Asset			
No Assets	48 (60.0)	32 (40.0)	80 (100.0)
Assets	443 (59.0)	308 (41.0)	751 (100.0)
Missing	211 (63.9)	119 (36.1)	330 (100.0)
Marital Status			
Married	584 (62.0)	358 (38.0)	942 (100.0)
Non-married	118 (53.9)	101 (46.1)	219 (100.0)
Residence place			
Urban	236 (67.4)	114 (32.6)	350 (100.0)
Suburban	247 (61.8)	153 (38.3)	400 (100.0)
Rural	219 (53.3)	192 (46.7)	411 (100.0)
Age			
	427 (61.1)	272 (38.9)	699 (100.0)
	275 (59.5)	187 (40.5)	462 (100.0)

Table 5. Odds Ratios (95% confidence intervals) of Mortality by Independent Variables

	1971		1981	
Race				
Black	1.18	(0.88 - 1.58)	1.05	(0.63 - 1.76)
Others	0.95	(0.35 - 2.54)	1.58	(0.42 - 5.87)
White	-		-	
Education				
0-8 years	1.09	(0.70 - 1.70)	1.33	(0.74 - 2.39)
9-11 years	0.99	(0.64 - 1.54)	0.99	(0.56 - 1.75)
12+ years	-		-	
Income				
Bottom 25%	2.21	(1.37 - 3.55)***	0.64	(0.28 - 1.49)
Low 25%	1.65	(1.04 - 2.63)**	1.20	(0.61 - 2.35)
High 25%	1.86	(1.20 - 2.89)***	1.37	(0.77 - 2.45)
Missing	1.5	(0.96 - 2.35)*	1.04	(0.59 - 1.82)
Highest 25%	-		-	
Asset				
No Assets	0.93	(0.62 - 1.39)	2.25	(1.13 - 4.47)*
Missing	0.89	(0.65 - 1.22)	0.81	(0.49 - 1.33)
	-		-	
Marital Status				
Non-Married	1.49	(0.79 - 2.81)	0.84	(0.52 - 1.35)
Married	-		-	
Residence Place				
Urban	1.73	(1.28 - 2.34)***	1.36	(0.84 - 2.19)
Suburban	0.82	(0.58 - 1.16)	0.93	(0.58 - 1.51)
Rural	-		-	
Health Limitation				
Limitation	3.52	(2.71 - 4.56)***	0.69	(0.47 - 0.01)*
Non-Limit	-		-	
Age				
Low	0.99	(0.77 - 1.28)	0.53	(0.36 - 0.78)**
High	-		-	
Constant		0.03		0.21***
R^2		.119		.063
N		2,599		1,063

†: $p < .15$
* : $p < .05$
**: $p < .01$
***: $p < .001$

Table 6. Odds Ratios (95% confidence intervals) of Health Limitation by Independent Variables

	1971		1981	
Race				
Black	0.71	(0.57 - 0.88)***	0.75	(0.53 - 1.06)†
Others	0.96	(0.48 - 1.88)	0.49	(0.17 - 1.41)
White	-		-	
Education				
0-8 years	1.32	(0.99 - 1.77)*	0.83	(0.57 - 1.20)
9-11 years	1.05	(0.79 - 1.40)	0.81	(0.58 - 1.14)
12+ years	-		-	
Income				
Bottom 25%	5.27	(3.82 - 7.26)***	3.02	(1.80 - 5.08)***
Low 25%	2.27	(1.69 - 3.06)***	1.52	(0.97 - 2.38)*
High 25%	1.28	(0.96 - 1.71)*	1.43	(0.98 - 2.09)*
Missing	1.90	(1.43 - 2.52)***	1.10	(0.78 - 1.56)
Highest 25%	-		-	
Asset				
No Assets	1.38	(1.02 - 1.87)**	0.86	(0.51 - 1.47)
Missing	1.01	(0.82 - 1.25)	0.88	(0.65 - 1.19)
	-		-	
Marital Status				
Non-Married	1.14	(0.74 - 1.76)	0.76	(0.55 - 1.05)*
Married	-		-	
Residence Place				
Urban	0.88	(0.71 - 1.09)	0.60	(0.44 - 0.82)***
Suburban	0.82	(0.66 - 1.02)*	0.74	(0.56 - 0.99)**
Rural	-		-	
Age				
Low	0.64	(0.54 - 0.76)	1.00	(0.78 - 1.28)
High	-		-	
Constant	0.30 ***		1.08	
R^2	.124		.056	
N	2,606		1,158	

†: $p < .15$
* : $p < .05$
**: $p < .01$
***: $p < .001$