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A Factor Analysis of Age Structural Change in Asia

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ABSTRACT---- ***In this paper, an analysis of age structural change in Asia was conducted. We should remember that Asia is the most populated continent, which population changes all the time so it explained the need of this research. Asia is the largest populous continent on earth with 30% of the world's land area and 60% of the world's current population as of 2016. The present paper is concerned with the study of the nature of age structural change in Asia. Using age classification variables and with the help of factor analysis, the paper attempts to answer a question what happened to the age group composition due to the effect of demographic transition. This paper attempts to analyze the interrelationships among the age groups in 34 countries of Asia during the period 1951 to 2016. Age structure varied substantially among the countries of Asia. The variation in age structure were explained by four factor model for male age groups and three factor model for female age groups. The study also shows that the variation in life expectancy is an important factor responsible for the variation in percentage of age group 15-80+ for males as well as females. However, fertility rate is also found to be inversely related to variation in the percentage of age group 15-80+ for females.***

Keywords--- age, structure, factor, loadings

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1. INTRODUCTION

There is an interaction between demographic processes and the age structure. Changing mortality rates, fertility rates, migration, life expectancy etc. are some of the important driving forces behind the age structural change. The age structural transition is a long-term process which completely reshapes a population's age structure. As a population undergoes the demographic transition, in which mortality and fertility rates decline, it moves from a young age structure towards an old age structure. Recent authors have termed this process the age structural transition (e.g. Pool et al. 2006), and it is seen to be an integral part of the demographic transition. Asia is the largest and most populous of earth's continents and its located in both the northern and eastern hemispheres. Asia comprises a 30% of the world's land area with 60% of the world's current population. It also has the highest growth rate today, and its population almost quadrupled during the 20th century. Asia has the two most populous countries in its borders: China and India. China is currently the most populous country on earth with an estimated population in 2016 of 1,377,124,512. It accounts for 31.69% of Asia's total population and over 18% of the world's population. India is not too far behind with an estimated population of 1,285,800,000, accounting for 29.36% of the continent's population and 17.5% of the world's population(World Population Review,2017).

How the change in demographic processes like increasing life expectancy and declining fertility rate have changed the population age structure? The purpose of this paper is to find the nature of change in the age structure for both the males and females in 34 countires in Asia during the period 1951 to 2016. It is concerned with the analysis of interdependence among the age groups. It also explains the factors responsible for the variation in the percentage of age groups in 15-80+ for both male and females across 34 countires for 2015. Higher life expectancy and lower fertility rate cause larger transformation in the age structure.

2. MATERIALS AND METHODS

This paper is mainly concerned with an analysis to determine if there is a significant interdependence among the population age groups across 34 countries of Asia during the period 1951-2016. Interdependence among 17 age group variables are analyzed with factor analysis which is used to reduce the dimension of 17 variables into a few factors. A factor analysis has been carried out to find out the dynamics of age structural change. We have the following dependent variables for various age groups (in years) separately for males and females: 0-4, 5-9 10-14, 15-19, 20-24, 25-29, 30-34, 35-39, 40-44,45-49, 50-54, 55-59, 60-64, 65-69, 70-74, 75-79, 80+. All population dependent variables are given in thousands. Data has been collected from Asian Statistical Year Books published by UN Economic Commission for Asia (UNESCAP).

A factor analysis has been carried out on the percentages of 17 age groups in 34 countries in Asia for the years 1951 to 2016, separately for males and females. Factor analysis has aims that are similar to those of principal components analysis. The basic idea is that may be possible to describe a set of p variables x1, x2…xp in terms of a smaller number of indices or factors and in the process got a better understanding of the relationship between these variables. There is, however, one important difference. Principal component analysis is not based on any particular statistical model, whereas factor analysis is based on a model(Manly, 2005). For analytical purpose, seventeen age groups are also consolidated into three age groups:1)Young age population (0-14), 2)Active age population (15-64) and 3)Old age population (65-80+). A regression analysis has also been carried out on the basis of results of factor analysis to find out the factors responsible for the variation in the percentage of age groups 15-80+ across the countries for 2015.

3. EMPIRICAL RESULTS

The distribution of percentage of male age group 0-14 for 1951 and 2016(Fig 1) are unimodal and the data are fairly symmetrical. The mean percentage of male age group 0-14 has declined from 37.33 in 1951 to 25.83 in 2016 and its standard deviation has increased from 4.40 to 7.01 during the same period. Maximum percentage of male age group 0-14 slightly declined from 45.70 to 43.79, but the minimum declined from 27.87 percent to 13.18 percent (Table 1). The distribution of percentage of female age group 0-14 for 1951 and 2016 (Fig 1) are bimodal and the data are fairly symmetrical. The mean percentage of female age group 0-14 has declined from 36.50 in 1951 to 24.23 in 2016 and its standard deviation has increased from 5.59 to 7.34 during the same period. Maximum percentage of female age group 0-14 slightly declined from 46.89 to 44.30, but the minimum declined from 25.96 percent to 10.89 percent (Table 1).

Fig 1:Histogram for Age Group 0-14 by Gender and Year

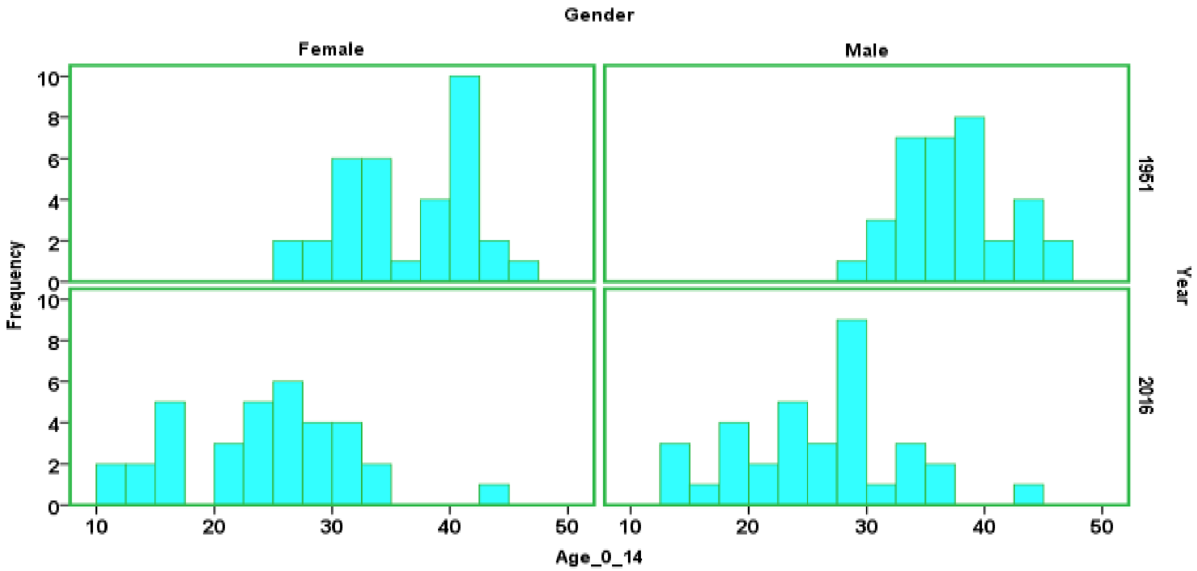


Table 1:Descriptive Statistics for Percentage of Age Groups in Asia by Gender and Year

Item			Female			Male		
	Year		0-14	15-64	65-80+	0-14	15-64	65-80+
	1951	Mean	36.50	58.69	4.81	37.33	58.54	4.13
		Median	37.07	58.57	4.42	36.82	58.57	3.62
		Minimum	25.96	50.56	.00	27.87	51.59	.00
		Maximum	46.89	68.16	11.12	45.70	67.38	11.23
		Range	20.93	17.60	11.12	17.83	15.79	11.23
		Std. Deviation	5.59	4.52	2.22	4.40	3.78	2.36
		Kurtosis	-1.02	-.91	1.30	-.45	-.40	1.41
		Skewness	-.20	.12	.81	.08	.06	1.09
	2016	Mean	24.23	67.31	8.46	25.84	67.54	6.62
		Median	24.92	67.44	5.92	26.19	67.35	5.10
		Minimum	10.89	52.96	2.73	13.18	53.98	2.22
		Maximum	44.30	73.97	29.12	43.79	74.45	23.41
		Range	33.41	21.01	26.39	30.61	20.47	21.19
		Std. Deviation	7.34	4.40	5.41	7.01	4.55	4.16
		Kurtosis	.31	2.27	5.20	.02	.91	7.24
		Skewness	.22	-1.07	1.99	.13	-.83	2.34

The distribution of male age group 15-64 for 1951 is slightly positively skewed(Fig 2), but the data are fairly symmetrical and it is slightly negatively skewed for 2016 (Fig 2), but fairly symmetrical. The mean percentage of male age group 15-64 increased from 58.54 in 1951 to 67.54 in 2016. Maximum percentage of male age group 15-64 increased from 67.38 in 1951 to 74.45 in 2016. Minimum percentage of male age group 15-64 slightly increased from 51.59 in 1951 to 53.58 in 2016. Range of percentage of male age group 15-64 increased from 15.79 in 1951 to 20.47 in 2016. The standard deviation of percentage of male age group 15-64 increased from 3.78 in 1951 to 4.55 in 2016 (Table 1). The distribution of female age group 15-64 for 1951 is bimodal, slightly positively skewed(Fig 2), but the data are fairly symmetrical and it is negatively skewed for 2016 (Fig 2), but fairly symmetrical. The mean of percentage of female age group 15-64 increased from 58.69 in 1951 to 67.31 in 2016. Maximum of percentage of female age group 15-64 increased from 68.16 in 1951 to 73.97 in 2016. Minimum of percentage of female age group 15-64 slightly increased from 50.56 in 1951 to 52.96 in 2016. Range of percentage of female age group 15-64 increased from 17.60 in 1951 to 21.01 in 2016. The standard deviation of percentage of female age group 15-64 declined from 4.52 in 1951 to 4.40 in 2016 (Table 1).

Fig 2:Histogram for Age Group 15-64 by Gender and Year

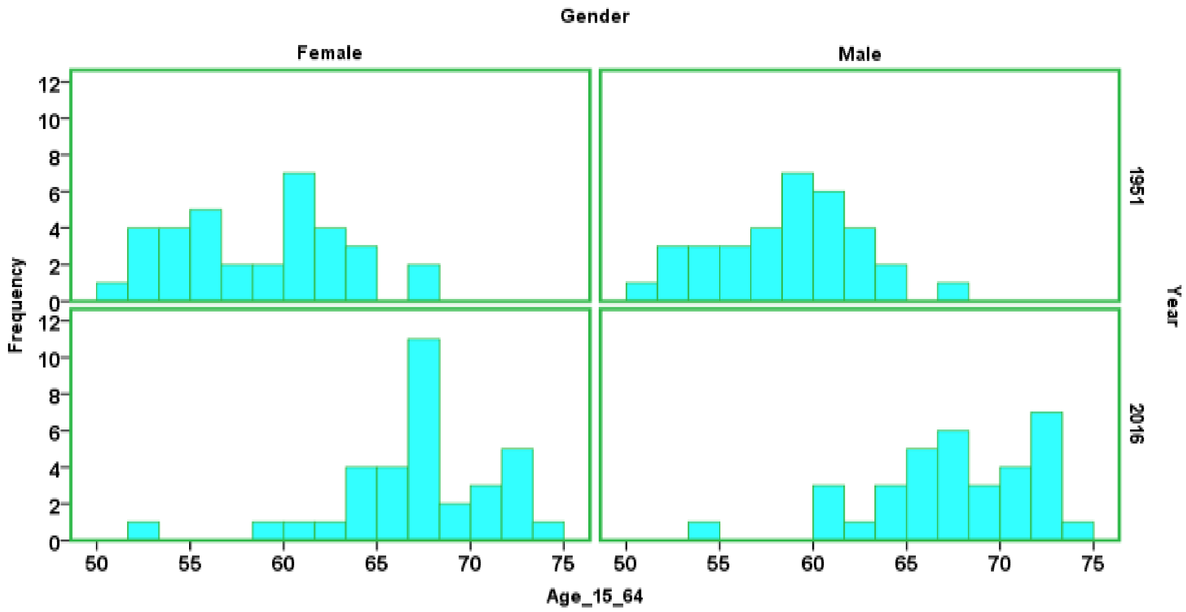
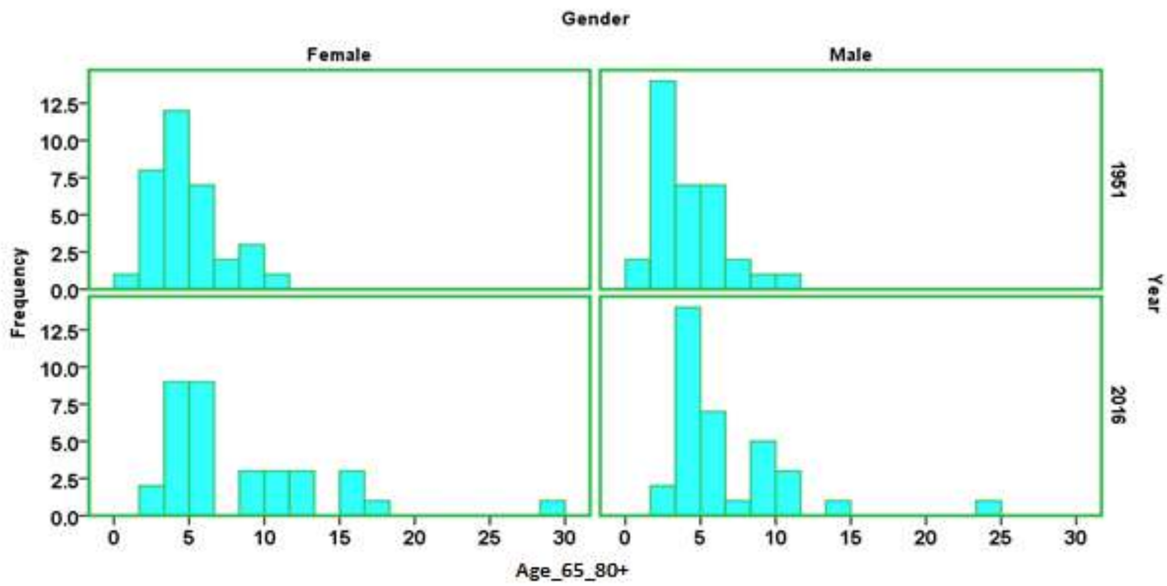


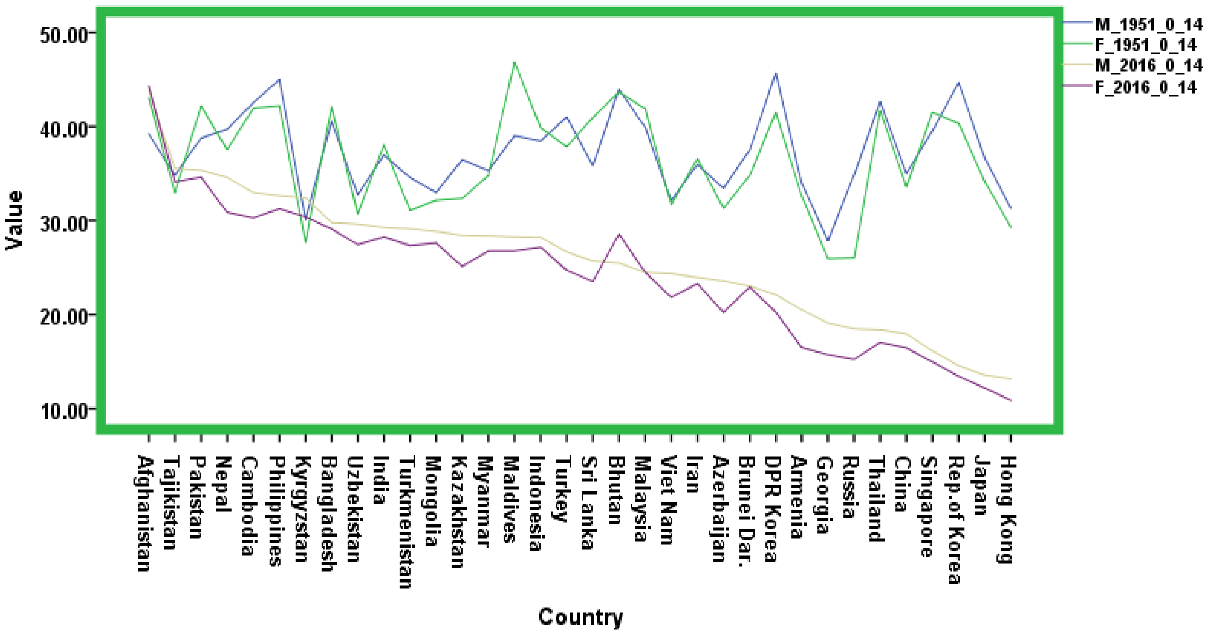
Fig 3:Histogram for Age Group 65-80+ by Gender and Year



The distribution of percentage male age group 65-80+ is unimodal and is more skewed positively for 2016(Fig 3) than for 1951(Fig 3). The mean of percentage of male age group 65-80+ increased from 4.13 in 1951 to 6.62 in 2016. Maximum percentage male age group 65-80+ increased from 11.23 in 1951 to 23.41 in 2016. Minimum percentage of male age group 65-80+ increased from 0 in 1951 tom 2.22 in 2016. Range of percentage of male age group 65-80+ increased from 11.23 in 1951 to 21.19 in 2016. The standard deviation of percentage of male age group 65-80+ increased from 2.36 in 1951 to 4.16 in 2016 (Table 1). The distribution of percentage female age group 65-80+ is unimodal and is more skewed positively for 2016(Fig 3) than the distribution for 1951(Fig 3). The mean percentage of female age group 65-80+ increased from 4.81 in 1951 to 8.46 in 2016. Maximum of percentage female age group 65-80+ increased from 11.12 in 1951 to 29.12 in 2016. Minimum of percentage of female age group 65-80+ increased from 0 in 1951 from 2.73 in 2016. Range of percentage of female age group 65-80+ increased from 11.12 in 1951 to 26.39 in 2016. The standard deviation of percentage of female age group 65-80+ increased from 2.22 in 1951 to 5.41 in 2016 (Table 1).

About 44 percent male population were in the 0-14 age group for Afghanistan in 2016. The percentage of male and female population in the age group 0-14 exceeded 34 for Tajikistan and Pakistan in 2016. The percentage of male and female population in the age group 0-14 varied between 30 and 34 for Nepal, Cambodia, Philippines and Kyrgyzstan. The percentage of male population in the age group 0-14 varied between 13 to 20 for Hongkong, Japan, Republic of Korea, Singapore, China, Thailand, Russia and Georgia in 2016. The percentage of female population in the age group 0-14 varied between 10 to 15 for Hongkong, Japan, Republic of Korea, Singapore, China, Thailand, Russia and Georgia in 2016 (Fig 4).

Fig 4:Percentage of Male and Female Population for the age Group 0-14 for 1951 and 2016



The percentage of male population in the age group 15-64 for Republc of Korea, Brunei, Singapore, China, Russia, Thailand, Hongkong, Azebaijan, DPR Korea, Iran, Vietnam and Armenia exeeded 70 in 2016. This is also true for the female component except Russia, DPR Korea and Vietnam in 2016. The percentage of male population in the age group 15-64 is observed to be below 65 in Kyrgystan, Cambodia, Philippines, Japan, Tajikistan, nepal and Afghanistan in 2016. This is also true for similar female component in 2016 (Fig 5).

The percentage of male population in the age group 65-80+ varied between 2.22 and 4.99 for Bangladesh,Kazakhstan, Maldives, Myanmar, Azerbaijan,Indonesia,Pakistan,Uzbekistan, Philippines,Brunei, Mongolia, Cambodia, Kyrgyzstan, Turkmenistan, Tajikistan and Afghanistan. This is also true for female component in those countries except Kazakhstan, Myanmar, Azerbaijan, Indonesia, Uzbekistan, Philippines and Kyrgyzstan(Fig 3). It is also notable that the percentage of male population in the age group 65-80+ found to be 23.4 percent for Japan, 14.98 percent for Hongkong and above 8 for Georgia, Republics of Korea, Singapore, Thailand, Russia, Armenia, China and Srilanka (Fig 6).

Fig 5:Percentage of Male and Female Population for the age Group 15-64 for 1951 and 2016

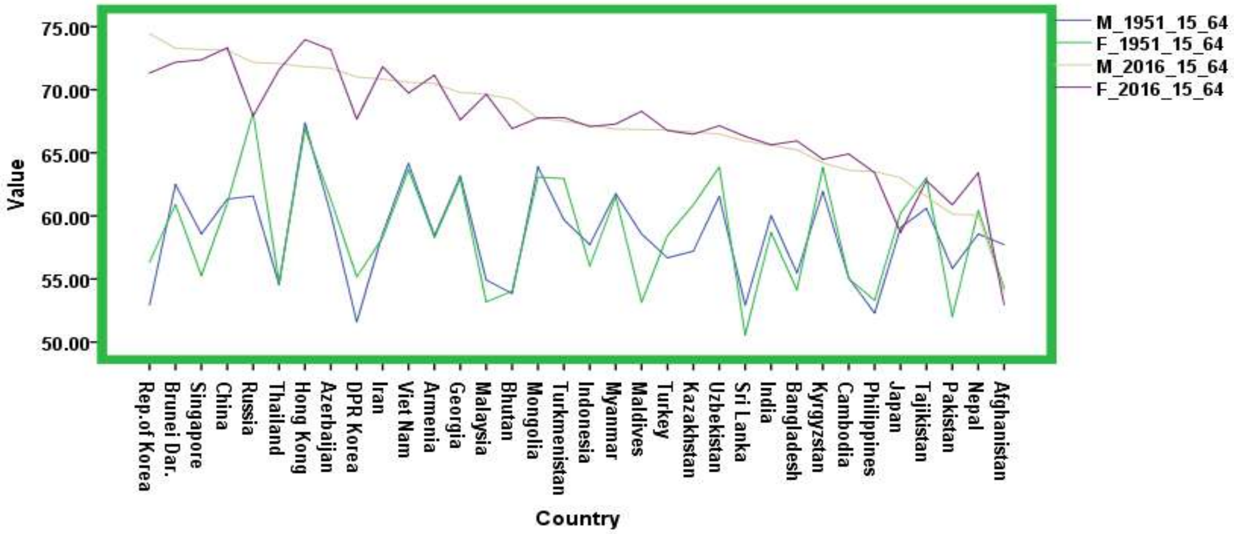


Fig 6:Percentage of Male and Female Population for the age Group 65-80+ for 1951 and 2016

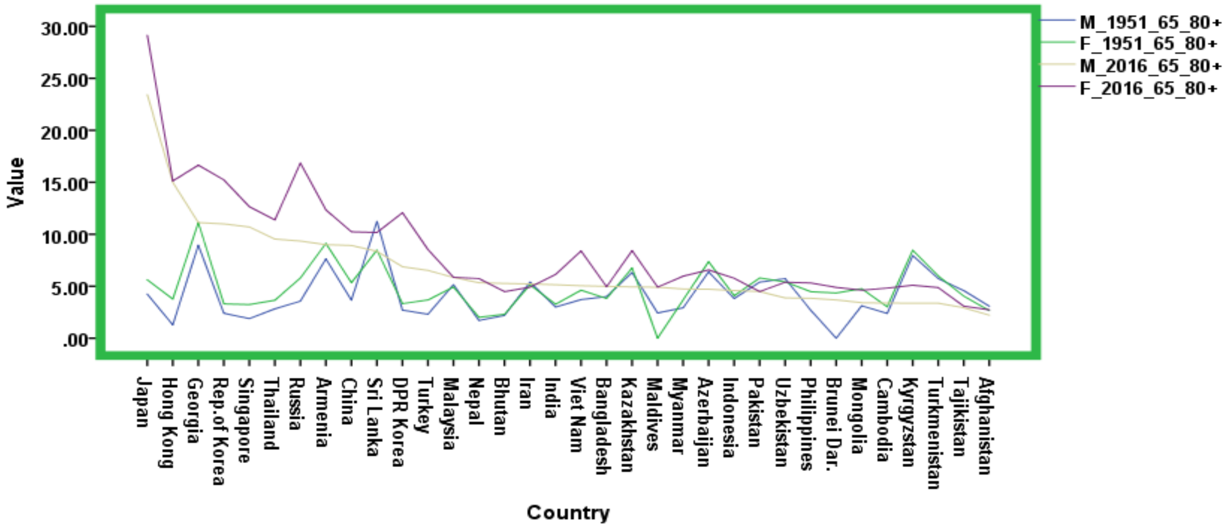
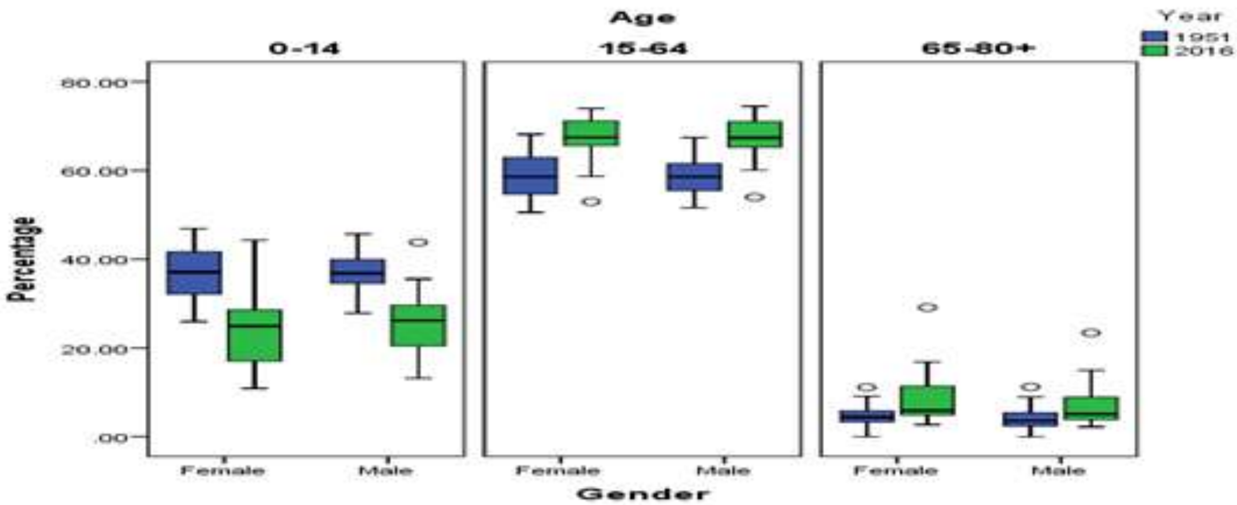


Fig 7: Boxplot for age groups by Gender and Year



The average percentage of male and female population in the age group 0-14 has declined, but inter-quartile range(IQR) increased in 2016. The average percentage of male and female population in the age group 15-64 increased in 2016, but IQR slightly decreased in 2016. The mean male and female population in the age group 65-80+ increased and the IQR also increased in 2016. The mean of percentage of male in the age group 0-14 exceeded that of female, however, IQR in the percentage of female in the age group 0-14 exceeded that of male in the same age group. The mean percentage of male population in the age group 0-14 is slightly higher than that of female in 2016. However, IQR of percentage of population of females in the age group 0-14 exceeded that of males (Fig 7).

Table 3:Correlations Matrix for Male Age groups in 34 Asian Countries during 1951-2016

	0-4	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75-79
0-4	1.0															
5-9	.84	1.0														
10-14	.53	.78	1.0													
15-19	.16	.27	.63	1.0												
20-24	-.13	-.22	-.01	.53	1.0											
25-29	-.30	-.42	-.48	-.09	.52	1.0										
30-34	-.48	-.44	-.54	-.48	-.01	.58	1.0									
35-39	-.66	-.56	-.47	-.46	-.26	.19	.68	1.0								
40-44	-.76	-.72	-.54	-.31	-.16	.05	.39	.76	1.0							
45-49	-.76	-.82	-.68	-.35	-.02	.12	.25	.53	.81	1.0						
50-54	-.68	-.80	-.78	-.49	-.07	.20	.28	.39	.62	.84	1.0					
55-59	-.65	-.73	-.75	-.59	-.21	.12	.33	.41	.50	.69	.86	1.0				
60-64	-.64	-.68	-.63	-.53	-.28	-.01	.23	.44	.51	.58	.71	.86	1.0			
65-69	-.63	-.67	-.60	-.42	-.23	-.05	.14	.36	.54	.59	.62	.74	.87	1.0		
70-74	-.64	-.68	-.61	-.42	-.17	.00	.14	.31	.49	.63	.66	.71	.78	.86	1.0	
75-79	-.60	-.66	-.62	-.44	-.16	.07	.18	.28	.42	.56	.66	.70	.73	.78	.89	1.0
80+	-.55	-.58	-.56	-.44	-.21	.00	.17	.29	.40	.50	.59	.66	.70	.73	.82	.92

The correlation matrix for the seventeen percentage age groups, separately for males and females are given in Tables 3 and 4 respectively. Most of the correlations between various age groups for males and females are well above 0.30. So we'll go ahead with the factor analysis.

Table 4: Correlation Matrix for Female Age Groups in 34 Asian Countries during 1951-2016

	0-4	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75-79
0-4	1.00															
5-9	.87	1.0														
10-14	.62	.82	1.0													
15-19	.31	.42	.72	1.0												
20-24	-.02	-.05	.15	.59	1.0											
25-29	-.28	-.35	-.34	.00	.56	1.0										
30-34	-.50	-.47	-.52	-.42	.04	.60	1.0									
35-39	-.67	-.62	-.52	-.49	-.24	.22	.67	1.0								
40-44	-.77	-.77	-.64	-.41	-.23	.06	.41	.75	1.0							
45-49	-.76	-.85	-.75	-.50	-.14	.07	.29	.56	.82	1.0						
50-54	-.71	-.83	-.83	-.61	-.24	.12	.27	.44	.66	.86	1.0					
55-59	-.68	-.75	-.80	-.70	-.36	.03	.33	.43	.56	.73	.88	1.0				
60-64	-.69	-.71	-.71	-.68	-.45	-.09	.25	.49	.56	.65	.76	.87	1.0			
65-69	-.71	-.72	-.66	-.55	-.41	-.16	.15	.42	.62	.66	.70	.78	.89	1.0		
70-74	-.73	-.75	-.71	-.56	-.31	-.08	.16	.38	.58	.72	.74	.77	.83	.90	1.0	
75-79	-.72	-.76	-.73	-.59	-.31	-.01	.20	.38	.54	.67	.77	.80	.82	.85	.92	1.0
80+	-.67	-.69	-.67	-.57	-.34	-.07	.19	.37	.49	.59	.68	.75	.79	.81	.87	.94

Table 5: KMO and Bartlett's Test

		Male Age Groups	Female Age groups
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.229	.264
Bartlett's Test of Sphericity	Approx. Chi-Square	72980.221	72980.221
	df	136	136
	Sig.	.000	.000

The KMO value for sampling adequacy indicates that what we have is pretty poor. Bartlett's test tests the null hypothesis that the correlation matrix is an identity matrix. An identity matrix is matrix in which all of the diagonal elements are 1 and all off diagonal elements are 0. You want to reject this null hypothesis. Bartlett's test of sphericity with an associated p value of < 0.001 indicates that we can proceed (Table 5). Taken together, these tests provide a minimum standard which should be passed before a factor analysis or a principal components analysis should be conducted.

Next is a table of estimated communalities, i.e. estimates of that part of the variability in each variable that is shared with others, and which is not due to measurement error or latent variable influence on the observed variable. Communalities indicate the amount of variance in each variable that is accounted for. The initial values can be ignored. The values in extraction column indicate the proportion of each variable's variance that can be explained by the retained factors. Variables with high values are well represented in the common factor space, while variables with low values are not well represented. In this case, we don't have any particularly low values (Table 6).

Table 6: Communalities (Male and Female Age Groups)

Age Groups	Males		Females		Age Groups	Males		Females	
	Initial	Extraction	Initial	Extraction		Initial	Extraction	Initial	Extraction
0-4	1.00	.88	1.00	.84	45-49	1.00	.82	1.00	.75
5-9	1.00	.95	1.00	.95	50-54	1.00	.77	1.00	.80
10-14	1.00	.85	1.00	.80	55-59	1.00	.81	1.00	.82
15-19	1.00	.89	1.00	.79	60-64	1.00	.82	1.00	.86
20-24	1.00	.91	1.00	.91	65-69	1.00	.82	1.00	.86
25-29	1.00	.91	1.00	.77	70-74	1.00	.87	1.00	.90
30-34	1.00	.85	1.00	.85	75-79	1.00	.86	1.00	.89
35-39	1.00	.88	1.00	.76	80+	1.00	.77	1.00	.80
40-44	1.00	.91	1.00	.65					

Table 7:Total Variance Explained: Male Age Groups

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	9.33	54.86	54.86	9.33	54.86	54.86	6.67	39.25	39.25
2	2.33	13.69	68.55	2.33	13.69	68.55	3.56	20.94	60.19
3	1.67	9.84	78.39	1.67	9.84	78.39	2.42	14.26	74.45
4	1.26	7.43	85.82	1.26	7.43	85.82	1.93	11.37	85.82

The eigenvalues and eigenvectors of the correlation matrix are shown in Table 7 and Table 8 for male and female age groups respectively. There are four eigenvectors greater than unity for male age groups and three eigenvectors greater than unity for female age groups. The first factor for male age groups accounted for 54.86 percent, the second 13.69 percent, the third 9.84 percent and the fourth 7.43 percent. Other factors are not significant for male age groups. First four components accounted for 85.82 percent variation in male age groups (Table 7). The first factor for female age groups accounted for 60.25 percent, the second 14.33 percent and the third 7.89 percent. Other factors are not significant for female age groups. First three components accounted for 82.46 percent variation in female age groups (Table 8). The scree plot graphs the eigenvalue against the factor number. From the fifth factor on (Fig 8), you can see that the line is almost flat, meaning the each successive factor is accounting for smaller and smaller amounts of the total variance in male age groups. Similarly, from the fourth factor on (Fig 9), you can see that the line is almost flat, meaning the each successive factor is accounting for smaller and smaller amounts of the total variance in female age groups.

Table 8:Total Variance Explained: Female Age Groups

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	10.24	60.25	60.25	10.24	60.25	60.25	8.59	50.52	50.523
2	2.44	14.33	74.58	2.44	14.33	74.58	3.21	18.91	69.432
3	1.34	7.89	82.46	1.34	7.89	82.46	2.22	13.03	82.465

Fig 8: Scree Plot for Male Age Groups

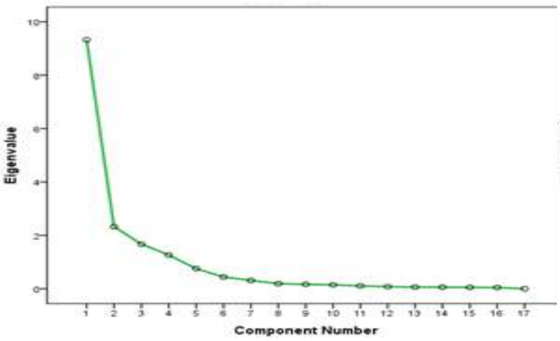


Fig 9:Scree Plot for Female Age Groups

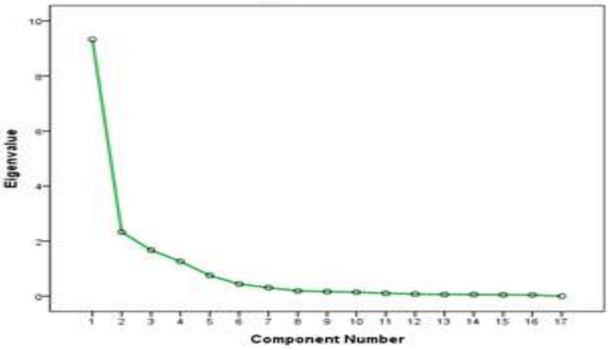


Table 9 reports the factor loadings for each age group variable on the unrotated components or factors. This table shows the loadings- extracted values of each item under 4 variables- of the 17 variables on the four factors extracted. The higher the absolute value of the loading, the more the factor contributes to the variable. We have extracted four variables wherein the 17 variables are divided into 4 variables or factors according to most important items which are similar responses in component 1 and simultaneously in components 2 , 3 and 4. We suppressed all loadings less than 0.5 so the empty spaces on the table represent loadings that are less than 0.5, this makes reading the table easier. Each number represents the correlation between the variable and the unrotated factor (e.g. the correlation between age group 0-4 and factor 1 is -0.82). These correlations can help you formulate an interpretation of the factors. This is done by looking for a common thread among the variables that have large loadings for a particular factor. It is possible to see items with large loadings on several of the unrotated factors, which can make interpretation difficult. In these cases, it can be helpful to examine a rotated solution. The unrotated factor loadings are presented in Table 10 which show the expected pattern, with high positive and high negative loadings on the first factor. Male age groups 0-4, 5-9, 10-14, 15-19 had high negative factor loadings on the first factor. Male age groups 35 and above had high positive factor loadings on the first factor. Factor 2 has high positive loadings for male age groups 20-24,25-29 and 30-34. Factor 3 has positive influence on male age groups 15-19 and 20-24 and low negative influence on male age groups 30-34 and 35-39. Factor 4 has low positive influence on male age group 40-44. Female age groups 0-4, groups5-9, 10-14, 15-19 had high negative factor loadings on the first factor for female age groups. Female age groups 35 and above had high positive factor loadings on the first factor for female age groups. Similarly, factor 2 has high positive loadings for female age groups 20-24, 25-29 and 30-34. Factor 3 has low positive loadings for female age groups 15-19 and 20-24(Table 9).

Table 9: Component Matrix

Age Groups	Males (Component)				Females (Component)			Age Groups	Males (Component)				Females (Component)		
	1	2	3	4	1	2	3		1	2	3	4	1	2	3
0-4	-.82				-.84			45-49	.83				.85		
05-09	-.88				-.90			50-54	.87				.89		
10-14	-.83				-.87			55-59	.88				.90		
15-19	-.58		.61		-.70		.52	60-64	.86				.89		
20-24		.65	.68			.68	.59	65-69	.83				.87		
25-29		.80				.87		70-74	.84				.89		
30-34		.59	-.51			.66		75-79	.82				.89		
35-39	.62		-.53		.64			80+	.77				.84		
40-44	.74			.55	.77										

Table 10:Rotated Component Matrix

Age Groups	Males (Component)				Females (Component)			Age Groups	Males (Component)				Females (Component)		
	1	2	3	4	1	2	3		1	2	3	4	1	2	3
0-4	-,51	-,74			-.79			45-49	,56	,70			.80		
05-09	-,64	-,59			-.85			50-54	,73				.84		
10-14	-,65		-,60		-.73	-.51		55-59	,80				.83		
15-19			-,50	,68			.63	60-64	,82				.83		
20-24				,93			.94	65-69	,85				.88		
25-29			,83			.61	.63	70-74	,90				.93		
30-34			,82			.91		75-79	,92				.92		
35-39		,79				.78		80+	,86				.86		
40-44		,89			.62	.50									

A varimax rotation with Kaiser normalization was carried out for male age groups. Rotation is a method used to simplify interpretation of a factor analysis. Only five male age group variable are appreciably dependent on more than one factor. Age groups 0-4 and 5-9 are negatively dependent on factor 1 and factor 2. Age group 10-14 is negatively dependent on factor 1 and factor 3. Age group 15-19 is negatively dependent on factor 3. Age group 15-19 is negatively dependent on factor 3 and positively dependent on factor 4. Age group 45-49 is positively dependent on factor 1 and factor 2. Factor 1 has a high positive loadings for age groups from 45-49 to 80+ and has high negative loadings for the age groups 0-4, 5-9, 10-14 and 15-19. Factor 1 has a high positive loading for male age groups 45-49 to 80+ and high negative loadings for 0-4 to 10-14. When trying to interpret the first factor, we can see that all variables that measure young male population in one way or another are highly negatively correlated with this factor. Similarly, we can see that all variables that measure old male population (45+) in one way or another are positively correlated with this factor. It therefore measures the extent to which male age group belonging to 45-80+ rather than children. This can be called as "45-80+" group. Factor 2 has high positive loadings for male age group 35-39 to 45-49 and fairly high negative loadings for male age group 0-4 to 5-9. This can be labelled as "35-49" group. Factor 3 has high positive loadings for male age group 25-29 to 30-34 and fairly high negative loadings for 10-14 to 15-19. This can be labelled as "25-34" group. Finally, factor 4 has high positive loadings for male age group 15-19 to 20-24. This can be labelled as "15-24" group.

Table 11: Country-wise and Gender-wise Factor Scores

Country	Male				Female			Country	Male				Female		
Factor	1	2	3	4	1	2	3		1	2	3	4	1	2	3
Brunei Dar.	-.89	.50	1.06	-.41	-.88	1.13	-.03	Tajikitstan	-.10	-.84	-.35	.05	-.33	-.57	-.02
Afghanistan	-.71	-.75	-.35	-.24	-1.03	-.60	-.23	Turkey	-.09	-.14	-.07	.05	-.11	-.14	-.05
Cambodia	-.69	-.49	-.40	.03	-.66	-.37	.13	Singapore	-.08	1.10	.60	-.24	.07	1.01	.16
Bhutan	-.63	-.15	.27	.01	-.85	-.04	.17	Thailand	-.02	.30	.05	-.03	-.05	.27	.07
Philippines	-.61	-.45	-.35	.08	-.59	-.48	.04	Pakistan	.01	-.54	-.33	-.13	-.59	-.49	.02
DPR Korea	-.53	.63	.21	.31	.23	.39	.24	Vietnams	.03	-.18	-.09	-.02	.19	-.30	-.12
Nepal	-.49	-.32	-.37	-.10	-.53	-.06	-.03	Kazakhstan	.08	.20	.23	.31	.64	.06	-.05
Maldives	-.36	-.24	-.41	.07	-1.06	-.09	.52	Azerbaijan	.09	-.08	-.09	.37	.41	-.09	.25
Indonesia	-.35	.05	.07	.06	-.36	.14	.22	China	.12	.60	.18	-.08	.19	.35	-.01
Bangladesh	-.33	-.31	-.25	-.06	-.72	.17	.06	Uzbekistan	.12	-.59	-.25	.28	.09	-.46	.06
Myanmar	-.32	.01	.01	-.01	-.28	.05	.01	Kyrgyzstan	.20	-.42	-.09	.20	.38	-.41	-.09
India	-.28	.03	.02	-.06	-.41	.11	.08	Sri Lanka	.52	-.07	-.06	-.04	-.02	.01	.16
Mongolia	-.21	-.11	-.06	-.01	-.19	-.19	-.08	Hong Kong	.61	1.04	.58	-.33	.66	1.07	-.35
Malaysia	-.21	-.14	-.08	.03	-.50	-.02	.28	Russia	.72	.97	.65	.05	2.02	.06	-.68
Turkmenistan	-.18	-.45	-.12	.23	-.10	-.26	.01	Armenia	.84	-.22	-.09	.27	.86	-.15	.17
Iran	-.17	-.36	-.10	.16	-.52	-.06	.29	Georgia	1.67	.16	-.06	-.17	1.81	-.20	-.53
Reprove Korea	-.12	.87	.11	-.05	.31	.49	.02	Japan	2.37	.35	-.06	-.56	1.94	.02	-.66

A varimax rotation with Kaiser normalization was also carried out for female age groups. Only three age groups are appreciably dependent on more than one factor. Age group 10-14 is negatively dependent on factor1 and factor 2. Age group 25-29 is positively dependent on factor 1 and factor 2. Age group 40-44 is positively dependent on factor 1 and factor 2.Female factor 1 has some high positive loadings for female age group 40-44 to 80+ and high negate loadings for female age groups 0-4 to 10-14. This can be labelled as "40-80+" group. Female factor 2 has a high positive loadings for female age groups 25-29 to 40-44 and moderate loadings for age group 10-14. This can be labelled as "25-44" age group. Female factor 3 has some high positive loadings for female age group 15-19 to 25-29 and can be labelled as "15-29" group(Table 10).

From studying the factor scores of male age groups, it can be seen that the values of factor 1 emphasize the importance of "45-80+" male age groups for Japan, Georgia, Armenia, Russia, Hongkong and Srilanka; With Brunei, Afghanistan, Cambodia, Bhutan, Philippines , DPR Korea and Nepal ,where the reverse is true. The values for factor 2 for male age groups indicate that Singapore,Hongkong, Russia, Rupublic of Korea, and China, "35-49" male age groups were important; with Tajikistan, Afghanistan, Uzbekistan and Pakistan, where the reverse is true. The values for factor 3 for male age groups contrast Brunei, Russia, Singapore and Hongkong -with high levels of '25-34" male age groups; with Maldives, Camboda and Nepal , where the reverse is true. The values for factor 4 for male age groups indicate that Azerbaijan, Kazakhstan and DPR Korea, where "15-29" groups were important; with Japan and Brunei, the reverse is true (Table 11).

From studying the factor scores of female age groups, it can be seen that the values for factors emphasize the importance of "40-80+" age groups in Russia, Japan, Georgia, Armenia, Hongkong and Kazakhstan; with Maldives, Afghanistan, Brunei, Bhutan, Bangladesh, Cambodia, Philippines, Pakistan, Nepal, Iran and Malaysia, where the reverse is true. The values of factor 2 for female age groups indicate that Brunei, Hongkong, Singapore and DPR Korea where "25-44" age groups were important; with Afghanistan, Tajikistan, and Pakistan, where the reverse is true. The values of factor 3 for female age group emphasize the importance of age-group 15-29 in Maldives; with Russia,, Japan, and Georgia, where the reverse is true(Table 11).

We can see that the percentage of age groups 15-80+ have experienced a rising trend for males (M15_80+) as well as females (F15_80+). An attempt has also been made to find the factors responsible for the variation in the percentage of age groups 15-80+ using cross-section data of 34 countries for 2015. The estimated log-log regression model for females is

$$\text{In F15\_80+} = 2.79 - \underset{(-6.66)}{0.22^{***}} \ln TFR + \underset{(2.90)}{0.39^{**}} \ln LEF \qquad \bar{R}^2 = 0.8775$$

The estimated model satisfied all the assumptions of OLS such as normal distribution of residuals, presence of homoscedasticity of residuals and absence of autocorrelation and multicollinearity. This model could explain 87.75 percent variation . The sign of regression coefficients are expected and significant. Percentage of age group 15-80+ for females (F15_80+) increased by 0.22 percent for every 1 percent decrease in TFR(Total fertility rate) holding LEF (life expectancy of females) constant. Every 1 percent increase in LEF has 0.39 percent increase in the percentage of age group 15-80+ for females in 2015 holding TFR constant.

The model for males is estimated with cubic root power transformation of M15-80+ (Percentage of age group 15-80+ for males) in order to fix heteroscedasticity. The estimated regression equation for males is

$$(\text{M15\_80+})^{\frac{1}{3}} = 2.90 + \underset{(6.48)}{0.02^{***}} \text{ LEM} \qquad \bar{R}^2 = 0.5539$$

The estimated model satisfied all the assumptions of OLS such as normal distribution of residuals, presence of homoscedasticity of residuals and absence of autocorrelation. This model could explain 55.39 percent variation in percent of male age group 15-80+. The sign of regression coefficient is expected and significant. The changes are the derivatives dY/dX, which the chain rule tells us are equal to $3\beta_i Y^2$. The regression estimates that a unit change in LEM will be associated with a change in Y of $3\beta_1(\widehat{\text{M15\_80}}+)^2 = 3\beta_1(\beta_0 + \beta_1 \text{LEM})^2$. A unit change in male life expectancy is associated with a change in 0.06 times the square root of the percentage of male age group m15_80+.

4. CONCLUSION

Demographic processes are undergoing unprecedented change in Asia. Highest percentage of population in the 0-14 age group has been observed for Afghanistan,Tajikistan, Pakistan, Nepal, Cambodia, Philippines and Kyrgyzstan. On the other hand, the lowest percentage of population in the age group 0-14 has been observed for Hongkong, Japan, Republic of Kora, Singapore, China, Russia, Georgia and Armenia. Similarly, highest percentage of population in the age group 15-64+ has been observed for Republic of Korea, Brunei, Singapore, China, Thailand, Hongkong,Azerbaijan, DPR Korea, Vietnam and Armenia. The lowest percentage of population in the age group 15-64+ found in Afghanstan, Nepal, Pakistan,, Tajiskistan, Japan, Phlippines, Cambodia and Kyrgyztan. The highest percentage of population in the age group 65-80+ found for Japan, Hongkong, Georgia, Republic of Korea,Singapore, Russia and Armena. Similarly, the lowest percentage of population in the age group 65-80+ has been found for Afghanistan, Tajikistan, Turmenistan, Cambodia, Mangolia, Brunei and Pakistan; this trend is also observed for males population in Kyrgyzsatn, Philippines and Uzbekistan and female population in Bhutan, Iran, Maldives and Bangladesh.

From studying the factor scores of male as well as female age groups, it can be seen that the values of factor 1 emphasize the importance of age groups "45-80+" for males or "40-80+" age groups for females for Japan, Georgia, Armenia, Russia and Hongkong. Positive influence of factor 2 on male and female age groups is also observed for Singapore, Republic of Korea, DPR Korea and Brunei. On the other hand, values of factor 1 emphasize the negative importance of "40-80+" male or female age groups in Afghanistan, Bhutan, Cambodia, Philippines, and Nepal. Negative influence of factor 1 on female age groups is observed for Pakistan, Maldives, Bangladesh, Brunei and Iran. Negative influence of factor 2 on the male age groups is also observed in Afghanistan, Cambodia, Philippines, Maldives, Pakistan, Tajikistan, Uzebekistan, Turkimenistan and Kyrgyzstan. Estimated log-log regression equation for females show that the percentage of female age groups F15_80+ was positively influenced by female life expectancy and negatively influenced by fertility rate. Similarly, the cubic root power regression equation estimated for males show that the percentage of male age groups m15-80+ is positively influenced by life expectancy of males. In order to achieve higher percentage of people in the age groups 15-80+, policies that enhancing the life expectancy and reducing fertility rate are required.

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