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Post-pandemic assessment of public knowledge, behavior, and skill on influenza prevention among the general population of Beijing, China

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SUMMARY

Background: The aim of this study was to assess the knowledge, behavioral, and skill responses toward influenza in the general population of Beijing after pandemic influenza A (H1N1) 2009.
Methods: A cross-sectional study was conducted in Beijing, China, in January 2011. A survey was conducted in which information was collected using a standardized questionnaire. A comprehensive evaluation index system of health literacy related to influenza was built to evaluate the level of health literacy regarding influenza prevention and control among residents in Beijing.
Results: Thirteen thousand and fifty-three valid questionnaires were received. The average score for the sum of knowledge, behavior, and skill was 14.12 ± 3.22, and the mean scores for knowledge, behavior, and skill were 4.65 ± 1.20, 7.25 ± 1.94, and 2.21 ± 1.31, respectively. The qualified proportions of these three sections were 23.7%, 11.9%, and 43.4%, respectively, and the total proportion with a qualified level was 6.7%. There were significant differences in health literacy level related to influenza among the different gender, age, educational level, occupational status, and location groups ($p < 0.05$). There was a significant association between knowledge and behavior ($r = 0.084$, $p < 0.001$), and knowledge and skill ($r = 0.102$, $p < 0.001$).
Conclusions: The health literacy level remains low among the general population in Beijing and the extent of relativities in knowledge, behavior, and skill about influenza was found to be weak. Therefore, improvements are needed in terms of certain aspects, particularly for the elderly and the population of rural districts. Educational level, as a significant factor in reducing the spread of influenza, should be considered seriously when intervention strategies are implemented.

1. Introduction

Pandemic influenza A (H1N1) 2009, a new strain of triple-reassortant influenza A virus composed of a combination of human, swine, and Eurasian avian strains, spread rapidly through more than 200 countries[1] and was the first global pandemic of the 21st century.[2,3] On August 10, 2010 the World Health Organization (WHO) declared that we had entered the post-pandemic period and the H1N1 virus had taken on the behavior of a seasonal influenza virus.[4]

There was an effective control and prevention campaign during and after the 2009 influenza pandemic in Beijing, which included identifying, treating, and isolating people who had the disease and educating the public about the steps that individuals could take to reduce the risk of transmission. Meanwhile, health education campaigns touching on good hygiene practices and social distancing were implemented in hospitals, schools, local communities, and through mass media.[5]

Since the severe acute respiratory syndrome (SARS) outbreak in 2003, the government of China has strengthened its surveillance and established the prevention and control system for infectious disease.[6] The level of science and technology in this field in China has since improved significantly. Compared with the abundant research on how the government and institutions could improve the surveillance management and prevention system, there have been few public reports assessing the effect of these policies and the level of health literacy associated with influenza prevention in the general population.

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It has been shown that health education is directed towards improving health literacy[7] and it is expected that this would have a positive effect on influenza prevention and control in the future.

There has been no investigation regarding health literacy of influenza prevention in the general population of Beijing. After the 2009 pandemic, it was necessary to collect some baseline data to understand and monitor public perceptions and behaviors. We conducted a survey in six districts of Beijing, China, in early 2011 to assess the influenza-related health literacy level in the general population of Beijing after the 2009 influenza pandemic, and to explore the behavior and skill factors affecting the incidence level of influenza.

2. Methods

2.1. Study subjects

A cross-sectional study was conducted in Beijing, China, in January 2011. Subjects were recruited via a multi-stage stratified cluster sampling technique. First, three urban districts and three rural districts were selected randomly from a total of 18 districts in Beijing. Five sub-districts/towns were then selected randomly in each of the six districts, from which five communities were selected randomly. Lastly, 18 subjects for each age group (18–29, 30–39, 40–49, 50–59, and ≥60 years) were recruited from each community, with equal weighting of the sexes.

2.2. Survey contents

The standardized interview questionnaire was designed to collect the following data: (1) socio-demographic characteristics (gender, age, education, occupation, and general health status); (2) knowledge about the disease and its symptoms; (3) practices towards influenza and people with influenza-like-illness (i.e., avoidance practices, cough etiquette, use of masks, hand washing, being vaccinated, health-seeking behaviors); (4) perceived ability to avoid illness; (5) attitudes towards the vaccine, and (6) comprehension of health materials related to influenza (i.e., medication instructions, educational information about influenza and the vaccine). Lastly, participants were asked to gauge their ability to use a thermometer.

Table 1
Demographic characteristics of the study population

Characteristics	Urban (n = 6431)		Rural (n = 6596)		Total (n = 13 027)	
	No.	%	No.	%	No.	%
Sex						
Male	3105	48.3	3190	48.3	6295	48.3
Female	3326	51.7	3406	51.6	6732	51.7
Age group, years						
18–29	1309	20.4	1396	21.1	2705	20.8
30–39	1280	19.9	1267	19.2	2547	19.5
40–49	1294	20.1	1311	19.9	2605	20.0
50–59	1306	20.3	1343	20.3	2649	20.3
60 or more	1242	19.3	1287	19.5	2529	19.4
Education level						
Illiterate/semi-literate[a]	89	1.4	298	4.5	387	3.0
Elementary school	329	5.1	1089	16.5	1418	10.9
Junior middle school	1132	17.6	2546	38.6	3678	28.2
Senior middle school	1954	30.4	1742	26.4	3696	28.4
University and higher	2923	45.5	920	13.9	3843	29.5
Occupational status						
Student	201	3.1	235	3.6	436	3.3
At work	3988	62.0	5349	81.0	9337	71.6
Non-working	2242	34.9	1020	15.4	3262	25.0

[a] Illiterate or know less than 1000 characters.

Questions were divided into three sections under the headings of knowledge, behaviors, and skills.

2.3. Data collection

After obtaining informed consent from the subject, the survey was administered by face-to-face interview. For the purpose of analysis, each question that was answered positively was given a score of 1 and each question that was answered negatively or was answered as 'don't know' was given a score of 0. The total score for the three sections was 24 points: the total score for 'knowledge'

Table 2
Scores for knowledge, behavior, and skill about influenza among respondents

Group	Knowledge				Behavior				Skill			
	No. of responses	Mean ± SD	F	p-Value	No. of responses	Mean ± SD	F	p-Value	No. of responses	Mean ± SD	F	p-Value
Sex												
Male	6295	4.62 ± 1.22	4.925	0.026	6295	7.12 ± 1.96	92.904	0.000	6277	2.20 ± 1.31	1.750	0.186
Female	6732	4.67 ± 1.18			6732	7.38 ± 1.91			6716	2.23 ± 1.31		
Age group, years												
18–29	2705	4.73 ± 1.11	31.064	0.000	2705	7.32 ± 1.97	5.695	0.000	2697	2.51 ± 1.24	217.352	0.000
30–39	2547	4.78 ± 1.11			2547	7.38 ± 1.88			2540	2.54 ± 1.24		
40–49	2605	4.69 ± 1.17			2605	7.20 ± 1.87			2600	2.26 ± 1.28		
50–59	2649	4.61 ± 1.23			2649	7.16 ± 1.89			2640	2.09 ± 1.29		
60 or more	2529	4.44 ± 1.34			2529	7.23 ± 2.09			2517	1.64 ± 1.30		
Education level												
Illiterate/semi-literate[a]	387	3.70 ± 1.65	158.175	0.000	387	6.26 ± 2.17	99.843	0.000	385	0.65 ± 0.86	770.323	0.000
Elementary school	1418	4.23 ± 1.46			1418	6.74 ± 2.16			1412	1.22 ± 1.12		
Junior middle school	3678	4.56 ± 1.22			3678	7.10 ± 1.93			3664	1.92 ± 1.21		
Senior middle school	3696	4.77 ± 1.09			3696	7.30 ± 1.86			3690	2.41 ± 1.22		
University and higher	3843	4.87 ± 1.01			3843	7.65 ± 1.81			3837	2.83 ± 1.16		
Occupational status												
Student	436	4.71 ± 1.10	2.062	0.127	436	7.45 ± 2.00	3.322	0.036	432	2.57 ± 1.27	21.669	0.000
At work	9337	4.66 ± 1.20			9337	7.23 ± 1.95			9314	2.22 ± 1.32		
Non-working	3262	4.62 ± 1.20			3262	7.29 ± 1.90			3255	2.14 ± 1.30		
Region												
Urban	6431	4.73 ± 1.13	63.968	0.000	6431	7.38 ± 1.84	54.786	0.000	6423	2.45 ± 1.27	428.286	0.000
Rural	6604	4.57 ± 1.20			6604	7.13 ± 2.03			6578	1.98 ± 1.31		
Total	13 035	4.65 ± 1.20			13 035	7.25 ± 1.94			13 001	2.21 ± 1.31		

SD, standard deviation.
[a] Illiterate or know less than 1000 characters.

was 7 points, and a qualified level was considered to be 6–7 points; the total score for 'behavior' was 13 points, and a qualified level was considered to be 10–13 points; the total score for 'skill' was 4 points, and a qualified level was considered to be 3–4 points.

2.4. Statistical analysis

Questionnaire data were entered in duplicate using EpiData software, and data were analyzed using SPSS 18 statistical software (SPSS Inc., Chicago, IL, USA). Descriptive statistics, such as percentages, means, and standard deviations, were calculated. To analyze the significance of the continuous data, an analysis of variance (ANOVA) was applied. Chi-square tests of significance were used for analyses of categorical variables regarding the qualified proportion of the three sections. The relationships among knowledge, behavior, and skill were analyzed by correlation analysis. Statistical significance was accepted at $p < 0.05$ for all analyses.

2.5. Ethical considerations

This study was approved by the institutional review board and human research ethics committee of the Beijing Center for Disease Prevention and Control (CDC).

3. Results

3.1. Participant demographic characteristics

A total of 13 286 adults were approached; 13 053 valid questionnaires were received, giving an effective response rate was 98.1%. The demographic characteristics of participants are reported in Table 1.

3.2. Scores

The average score for the sum of knowledge, behavior, and skill was 14.12 ± 3.22, and the mean scores for knowledge, behavior, and skill were 4.65 ± 1.20, 7.25 ± 1.94, and 2.21 ± 1.31, respectively. The statistic of the total score of these three sections was found to follow an approximately normal distribution.

3.2.1. Knowledge assessment

The overall mean score for knowledge was 4.65 ± 1.20, and 23.7% of participants met the qualified standard of knowledge. Both the overall knowledge score and the qualified proportion for knowledge were significantly higher in urban areas compared to rural areas ($F = 63.968$, $p < 0.001$; Chi-square = 12.701, $p < 0.001$). The mean knowledge score fell significantly with increasing age ($F = 31.064$, $p < 0.001$) and increased significantly with higher educational levels ($F = 158.175$, $p < 0.001$) (Table 2). The qualified proportion in the different age groups fell significantly with increasing age (Chi-square = 20.991, $p < 0.001$) and increased significantly with higher educational levels (Chi-square = 92.145, $p < 0.001$) (Table 3).

3.2.2. Behavioral assessment

Males had a significantly higher mean score for behavior than females ($F = 92.904$, $p < 0.001$). The mean score of urban residents was significantly higher than that of rural residents ($F = 54.786$, $p < 0.001$). The mean score in the different age groups fell significantly with increasing age ($F = 5.965$, $p < 0.001$) and there was a significant rise with the increase in educational level ($F = 99.843$, $p < 0.001$) (Table 2).

Of the participants, 11.9% met the qualified standard of behavior. Males had a significantly higher qualified proportion

Table 3
The qualified proportions for knowledge, behavior, and skill about influenza among respondents

Group	Knowledge			Behavior			Skill			Total		
	Qualified (%)	Chi-square	p-Value	Qualified (%)	Chi-square	p-Value	Qualified (%)	Chi-square	p-Value	Qualified (%)	Chi-square	p-Value
Sex												
Male	1463/6295 (23.2)	1.356	0.244	679/6295 (10.8)	13.066	0.000	2716/6295 (43.1)	0.271	0.603	388/6295 (6.2)	5.180	0.023
Female	1623/6732 (24.1)			864/6732 (12.8)			2935/6732 (43.6)			482/6732 (7.2)		
Age group, years												
18–29	680/2705 (25.1)	20.991	0.000	345/2705 (12.8)	12.757	0.013	1404/2705 (51.9)	477.533	0.000	236/2705 (8.7)	43.039	0.000
30–39	654/2547 (25.7)			313/2547 (12.3)			1356/2547 (53.2)			203/2547 (8.0)		
40–49	611/2605 (23.5)			283/2605 (10.9)			1169/2605 (44.9)			159/2605 (6.1)		
50–59	618/2649 (23.3)			277/2649 (10.5)			1044/2649 (39.4)			148/2649 (5.6)		
60 or more	525/2529 (20.8)			327/2529 (12.9)			682/2529 (27.0)			126/2529 (5.0)		
Education level												
Illiterate/semi-literate[a]	47/387 (12.1)	92.145	0.000	30/387 (7.8)	61.584	0.000	22/387 (5.7)	1322.136	0.000	3/387 (0.8)	235.322	0.000
Elementary school	262/1418 (18.5)			144/1418 (10.2)			218/1418 (15.4)			41/1418 (2.9)		
Junior middle school	793/3678 (21.6)			355/3678 (9.7)			1276/3678 (34.7)			140/3678 (3.8)		
Senior middle school	936/3696 (25.3)			443/3696 (12.0)			1783/3696 (48.2)			253/3696 (6.8)		
University and higher	1049/3843 (27.3)			573/3843 (14.9)			2352/3843 (61.2)			435/3843 (11.3)		
Occupational status												
Student	110/436 (25.2)	4.258	0.119	72/436 (16.5)	9.381	0.009	235/436 (53.9)	31.165	0.000	52/436 (11.9)	23.116	0.000
At work	2247/9337 (24.1)			1092/9337 (11.7)			4097/9337 (43.9)			630/9337 (6.7)		
Non-working	731/3262 (22.4)			381/3262 (11.7)			1323/3262 (40.6)			190/3262 (5.8)		
Region												
Urban	1610/6431 (25.0)	12.701	0.000	783/6431 (12.2)	1.265	0.261	3107/6431 (48.3)	125.588	0.000	499/6431 (7.8)	23.265	0.000
Rural	1478/6604 (22.4)			762/6604 (11.5)			2548/6604 (38.6)			373/6604 (5.6)		
Total	3088/13 035 (23.7)			1545/13 035 (11.9)			5655/13 035 (43.4)			872/12 163 (6.7)		

[a] Illiterate or know less than 1000 characters.

Table 4
Association between respondents' knowledge level and behavior and skill

Measurements	Behavior		Total	*r*	*p*-Value	Skill		Total	*r*	*p*-Value
	Qualified	Not qualified				Qualified	Not qualified			
Knowledge level										
High	516 (16.7%)	2572 (83.3%)	3088 (100%)	0.084	0.000	1620 (52.5%)	1468 (47.5%)	3088 (100%)	0.102	0.000
Low	1029 (10.3%)	8918 (89.7%)	9947 (100%)			4035 (40.6%)	5912 (59.4%)	9947 (100%)		
Total	1545 (11.9%)	11 490 (88.1%)	13 035 (100%)			5655 (43.4%)	7380 (56.6%)	13 035 (100%)		

of behavior than females (Chi-square = 13.066, $p < 0.001$) and there was a significant rise with increasing educational levels (Chi-square = 61.584, $p < 0.001$) (Table 3).

3.3. Ability and skill assessment

Urban residents had a significantly higher mean score for skill than rural residents ($F = 428.286$, $p < 0.001$). The mean score for the different age groups fell significantly with increasing age ($F = 217.352$, $p < 0.001$) and increased significantly with higher educational levels ($F = 770.232$, $p < 0.001$). There was a significant difference among the three occupational status levels ($F = 21.669$, $p < 0.001$), with the group of students having the highest mean score (2.57 ± 1.27) and the non-working group having the lowest mean score (2.14 ± 1.30) (Table 2).

Of the participants, 43.4% met the qualified standard of skill. The qualified proportion of skill in urban residents was significantly higher than in rural residents (Chi-square = 125.588, $p < 0.001$). The qualified proportion in the different age groups fell significantly with increasing age (Chi-square = 477.533, $p < 0.001$) and increased significantly with higher educational levels (Chi-square = 1322.136, $p < 0.001$). There was a significant difference among the three occupational status levels (Chi-square = 31.165, $p < 0.001$), with the group of students having the highest qualified proportion (53.9%) and the non-working group having the lowest qualified proportion (40.6%) (Table 3).

3.4. Correlations between knowledge, behavior, and skill

There were positive correlations between knowledge and behavior, and knowledge and skill, which were statistically significant ($p < 0.001$). However, the extent was weak, as the correlation coefficients were $r = 0.084$ and $r = 0.102$, respectively (Table 4).

4. Discussion

In recent years, pandemic influenza, as a global public health problem, has caused worldwide concerns.[8,9] Many previous studies have shown that the risk of seasonal or pandemic influenza infection depends on biological characteristics, individual or collective behaviors, and the environmental context.[10] Research has been done on the knowledge, attitudes, and practices (KAP) related to pandemic influenza A (H1N1) 2009 among the Chinese general population,[11] but a related study has not been reported from Beijing. This study could provide some important information to fill the gaps in this field. It was necessary and valuable for us to conduct the study to determine the overall level of influenza-related health literacy in the general population of Beijing after the 2009 pandemic, data that provide a baseline for influenza prevention and control strategies in the future. Furthermore, our assessment may help shape policy and provide information to the international community.

In this study we found that the qualified proportion of urban residents was significantly higher than that of rural residents; this was considered to be associated with socio-economic factors, such as income and medical resources allocation,[12,13] as well as the ability to access health information. The socio-economic status in rural areas is significantly lower than in urban areas; rural residents are always less likely to obtain the recommended preventive healthcare services,[14] and their limited ability to acquire information via modern media systems[15] impedes the dissemination of health information among rural dwellers. In addition, most public education activities are currently carried out in the communities of urban districts, hence the public awareness of influenza-related knowledge, behavior, and skill of rural residents is lower than that of urban residents.

In this study, education was found to be the most important factor influencing levels of infectious disease health literacy, and past research on the relationship between education and health has drawn similar conclusions. Howard et al[16] found that if health literacy levels were similar, differences in self-reported health status by education would be about 20% lower. There is also some indirect evidence. Goldman and Smith[17] found that well-educated patients are better able to manage complicated self-care regimens in HIV/AIDS and diabetes. Other studies have found that education is linked to faster adoption of new medical technologies[18] and that consumer knowledge is linked to the increased use of preventive care.[19] In this study, the qualified levels of all three sections (knowledge, behavior, and skill) in the general population were significantly higher ($p < 0.001$) with a higher level of education, which is similar to the nationwide health literacy level of China.[20,21] At present, different intervention strategies aimed at populations with different levels of education should be implemented.

Compared with younger people, the older age groups had worse health literacy related to influenza. The qualified proportion in the older age group was significantly lower than that in the younger group. Older adults have lower immunity and ability to fight off disease and are at higher risk of becoming infected with influenza viruses. The risk of influenza-related complications and deaths among the elderly are significantly higher than in younger people.[22] The results of Beijing's sixth population census showed the proportion of elderly ($\geq$60 years) to be 12.5%,[23] demonstrating that Beijing has already become an aging society. The statistics in this study indicated that the influenza-related health literacy level among elderly residents in Beijing was low. As a high-risk and susceptible population, the elderly should be paid more attention with regard to influenza prevention and control.

There were positive correlations among knowledge, behavior, and skill about influenza, but the extent was weak. This indicates that there is still a gap in knowledge, behavior, and skill. Full knowledge about the prevention of influenza does not mean reasonable behavior or skill. It is necessary to carry out various types of health education program aimed at behavior and skill.

The study has a few limitations. First, some data were self-reported, which could have led to problems of recall bias. Second, this study was a sampling survey, which will inevitably have had a sampling bias. However, because the participants were selected from communities by strict random sampling, it is believed that they do represent the general population of Beijing. Thirdly, there were no baseline data for influenza-related health literacy in the general population of Beijing for the pre-pandemic period, so we cannot know whether the health literacy level of people was improved after pandemic (H1N1) 2009. People may have been referring to pandemic influenza or seasonal influenza in their responses.

In recent years, pandemic influenza, as a global public health problem, has caused worldwide concerns.[8,9] Many previous studies have shown that the risk of seasonal or pandemic influenza infection depends on biological characteristics, individual or collective behaviors and the environmental context.[10] As there has been no related study reported in Beijing, this study could provide some important information to fill gaps in this field. It was necessary and valuable for us to conduct the study to determine the overall level of influenza-related health literacy in the general population of Beijing after the 2009 pandemic, data that provide a baseline for influenza prevention and control strategies in the future. Furthermore, our assessment may help shape policy and provide information to the international community.

In conclusion, following the H1N1 2009 pandemic, the general population of Beijing has some correct knowledge, practices, and skills related to influenza, however this health literacy level is low and the extent of relativities in knowledge, behavior, and skill about influenza was found to be weak. Improvements are needed in terms of certain aspects, particularly for the elderly and the population of rural districts. Educational level, as a significant factor in reducing the spread of influenza, should be considered seriously when intervention strategies are implemented, and we should provide more individual health counseling and education services for residents.

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References

1. World Health Organization. Global Alert and Response (GAR): Pandemic (H1N1) 2009—update 112. Geneva: WHO; 2010. Available at: http://www.who.int/csr/don/2010_08_06/en/index.html (accessed: 10.08.13).
2. Fraser C, Donnelly CA, Cauchemez S, Hanage WP, Van Kerkhove, Kerkhove MD, Hollingsworth TD, et al. Pandemic potential of a strain of influenza A (H1N1): early findings. *Science* 2009;**324**:1557–61.
3. Scalera NM, Mossad SB. The first pandemic of the 21st century: a review of the 2009 pandemic variant influenza A (H1N1) virus. *Postgraduate Med* 2009;**121**:43–7.
4. World Health Organization. H1N1 in post-pandemic period. Geneva: WHO; 2010. Available at: http://www.who.int/mediacentre/news/statements/2010/h1n1_vpc_20100810/en/index.html (accessed: 10.08.13).
5. Liang W, Feng L, Xu C, Xiang N, Zhang Y, Shu Y, et al. Response to the first wave of pandemic (H1N1) 2009: experiences and lessons learnt from China. *Public Health* 2012;**126**:427–36.
6. Chan LH, Chen L, Xu J. China's engagement with global health diplomacy: was SARS a watershed? *PLoS Med* 2010;**7**:1–6.
7. Nutbeam D. Health literacy as a public health goal: a challenge for contemporary health education and communication strategies into the 21st century. *Health Promot Int* 2000;**15**:259–67.
8. Coker R, Mounier-Jack S. Pandemic influenza preparedness in the Asia-Pacific region. *Lancet* 2006;**368**:886–9.
9. Lau JT, Griffiths S, Choi KC, Tsui HY. Wide spread public misconception in the early phase of the H1N1 influenza epidemic. *J Infect* 2009;**59**:122–7.
10. Lapidus N, de Lamballerie X, Salez N, Setbon M, Ferrari P, Delabre RM, et al. Integrative study of pandemic A/H1N1 influenza infections: design and methods of the CoPanFlu-France cohort. *BMC Public Health* 2012;**12**:417.
11. Lin Y, Huang L, Nie S, Liu Z, Yu H, Yan W, Xu Y. Knowledge, attitudes and practices (KAP) related to the pandemic (H1N1) 2009 among Chinese general population: a telephone survey. *BMC Infect Dis* 2011;**11**:1–9.
12. Crighton EJ, Elliott SJ, Moineddin R, Kanaroglou P, Upshur RE. An exploratory spatial analysis of pneumonia and influenza hospitalizations in Ontario by age and gender. *Epidemiol Infect* 2007;**135**:253–61.
13. Whitehead M, Dahlgren G, Evans T. Equity and health sector reforms: can low-income countries escape the medical poverty trap? *Lancet* 2001;**358**:833–6.
14. Casey MM, Call KT. Are rural residents less likely to obtain recommended preventive healthcare services? *Am J Prev Med* 2001;**21**:182–8.
15. Sufen S. The construction and development status analysis on rural informatization in Beijing. *Chinese Agricultural Science Bulletin* 2009;**25**:456–9.
16. Howard DH, Sentell T, Gazmararian JA. Impact of health literacy on socioeconomic and racial differences in health in an elderly population. *J Gen Intern Med* 2006;**21**:857–61.
17. Goldman DP, Smith JP. Can patient self-management help explain the SES health gradient? *Proc Natl Acad Sci U S A* 2002;**99**:10929–34.
18. Lichtenberg FR, Lleras-Muney A. The effect of education on medical technology adoption: are the more educated more likely to use new drugs? National Bureau of Economic Research Working Paper No. 9185.. Cambridge: National Bureau of Economic Research; 2002.
19. Parente ST, Salkever S, DaVanzo J. The role of consumer knowledge of insurance benefits in the demand for preventive health care among the elderly. *Health Econ* 2005;**14**:25–38.
20. Ministry of Health of the People's Republic of China. 2009, the first time Chinese residents health literacy survey. Beijing: Ministry of Health; 2009.
21. China Association for Science and Technology. A survey of public scientific literacy in China. Beijing: China Association for Science and Technology; 2010
22. World Health Organization. Prevention and control of influenza—Recommendations of the Advisory Committee on Immunization Practices (ACIP). Geneva: WHO; 2008. Available at: http://new.paho.org/hq/dmdocuments/2010/Influenza%20vaccine%20and%20antiviral%20agents_CDC_MMWR%202008%2057.pdf (accessed: 10.08.13).
23. Beijing Municipal Bureau of Statistics. The sixth national population census, Beijing. Beijing: Municipal Bureau of Statistics; 2011; Available at: http://www.bjstats.gov.cn/rkpc_6/pcsj/201105/t20110530_203331.htm (accessed: 10.08.13).