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PHYSICAL ACTIVITY AND HEALTH

Yuan, L., et al. 2017 Quantitative Evaluation of Economic Level Effects on Physical Fitness Condition among Elderly Population in Hebei Province of China. *Physical Activity and Health,* 1(1), pp. 17–23, DOI: https://doi.org/10.5334/paah.6

RESEARCH

Quantitative Evaluation of Economic Level Effects on Physical Fitness Condition among Elderly Population in Hebei Province of China

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The purpose of this study is to investigate the influence of economic level on physical fitness condition among elderly population. Cities with regard to The National Physical Fitness Surveillance in Hebei province were divided into three regions based on variant economic levels. According to the properties of testing indexes and the functional coverage, this study classified test indexes as the body level, the organic tissues level, the cellular/molecular level, and quantitatively compared the differences between these levels. The results showed that the index value differences failed to reach significant level except for the balance ability which was significantly higher for cities with better economy condition than cities at general economic level and the capital city. Findings of this study indicates that the economic difference does not cause the effective stress of physical fitness improvement among elderly population. The complete biological function stress caused by the increased economic level is during plateau stage. In addition, the average BMI value of the elderly in Hebei province presented overweight feature despite of economic level, which should draw more focuses. The quantitative difference evaluation of the threshold point is applicable for health engineering research, but the application in other disciplines needs to be further studied.

Keywords: aging; quantitative difference; fitness health; golden section

Introduction

China became an "aging society" in 2000 and its elderly population has been increasing rapidly on the road to a "super aging society". As a primary task of public health care system, The National Physical Fitness Surveillance, practically among elderly population plays a critical role in improving the citizen life quality (Dai 2011). Both overweight and underweight are regarded as dangerous factors threatening human health for developing countries (Villamor et al. 2006). Deficits in physical fitness potentially impairs life quality, shortens life span and cause various clinical disease such as coronary heart disease, cardiopathy disease and diabetes (Krzysztoszek 2015). There is debates about association between regional economic level and physical fitness condition of local people. Some studies (General Administration of Sport of China2014) show that the physical fitness of adult in economically developed region are superior to those in less developed region. Among them, Jiang et al. (Jiang et al. 2004) reported that the physical fitness in Jiangsu province which was regarded as developed economy regions are obviously superior to that in less developed regions, while the difference of physical fitness between the developed economy areas and less developed areas are not obvious in Jiangsu province. That's indicated the physical fitness level and economic and social development is not coordinated in the similar level of economic development regions. Studies such as Fan et al. (Fan et al. 2012; Okafor et al. 2014;) have shown that the higher the standard of living, the more likely

to suffer from chronic diseases which caused by over nutrition and exercise too little. Jiang (Jiang et al. 1998) have suggested to institute a regional evaluation standards, integrating the national physical fitness into the social development evaluation index that the purpose is arouse people's attention to exercise.

The concept of "Health Industry" was initially defined by the Massachusetts General Hospital (Cobb 2010). Subsequently, based on Pareto theory (Pareto 1971; Liu et al. 2014), Liu et al. (Liu et al. 2013) reported that the healthy function of human body constituted Pareto network and divided body function as necessary function, key-unnecessary function and normal-unnecessary function. Moreover, they strictly defined the concept of Health, Sub-health and Disease based on the Arndt-Schulz Principle (Martius 1923). The aim of health industry (Cobb 2010) is to reconstruct sub-health/disease and eventually improve health, which is consistent with the notion of "Pre-disease treatment" in Chinese medicine. Today, the knowledge of health management is also an essential element in health industry (Cobb 2010), which requires researchers to effectively estimate human body function for both healthy and sub-healthy population.

P-value method has been commonly used for data statistics in analyzing results of The National Physical Fitness Surveillance (Dai 2011; Krzysztoszek 2015; Jiang et al. 2004; Jiang et al. 1998; Liu 2011; Li 2011). However, statistical significance is not the same as biological importance (Whitlook 2015). Compared with this traditional statistical method, Liu et al. (2017) proposed the concept of Quantitative difference (QD) which is calculated as the absolute value of golden logarithmic of the ratio between intergroup averages. For genomics and protein omics, the biological importance has been assessed with the well-known expression thresholds, 1.5-fold and 2.0-fold. In order to extend the ratio threshold, Liu et al. have introduced the QD, $1=|\log_{\tau}(\bar{x}/\bar{y})|\,(\tau=\sqrt{5}-1)/2\approx 0.618$. This advanced method solved the limitation of traditional method uncapable of addressing biological differences (Liu et al. 2016). This study used QD method to estimate the effects of progressive economic level on physical fitness condition among elderly population based on the annul data collected in the event of The National Physical Fitness Surveillance in 2014.

Methods

13 cities recruited in The National Physical Fitness Surveillance in Hebei province in 2104 were classified as capital city, high city, and general city according to the development of economy:

Capital City (CC) – polity and culture center with developed economy – Shijiazhuang;
High Level (HL) – economy developed – Tangshan, Qinhuangdao, Handan, Baoding, Cangzhou, Langfang;
General Level (GL) – economy less developed – Xingtai, Zhangjiakou, Chengde, Hengshui, Dingzhou, Xinji.

Information of sample size are listed in **Table 1**.

QD is defined as the absolute value of golden logarithmic of the ratio between intergroup averages (Liu et al. 2016). It was found that there is QD thresholds (α, β) so that it is significant if $\alpha \le l < \beta$ and extraordinarily significant if $l \ge \beta$. The QD thresholds (α, β) at the level of body, the level of organs or tissue and the level of cells, molecules or central nervous systems are (0.27, 0.47), (0.47, 0.80), (0.80, 1.22). According to the properties of testing indexes and the functional coverage, the indexes were classified as:

i. QD threshold at body level (Liu et al. 2016; Lin et al. 2014) is (0.27, 0.47): height, weight, body mass index, BMI, sit and reach (SR), grip strength (GS), single-leg standing while eyes closed (SSEC);
ii. QD threshold at organic or tissues level (Liu et al. 2016; Lin et al. 2014) is (0.47, 0.80):
    1) Anthropometry: Chest circumference, waist circumference, hip circumference, skinfold thickness of upper arm (STUA), skinfold thickness of scapula (STSC), skinfold thickness of abdomen (STAB);
    2) Cardiovascular function: Heart rate (HR), systolic pressure (SP), diastolic pressure (DP);
    3) Lung function: Vital capacity (VC).

Table 1: Sample size of The National Physical Fitness Surveillance in Hebei province in 2104.

Gender	CC	HL	FL	Total
Male	145	727	740	1612
Female	142	756	771	1669
Total	287	1483	1511	3281

iii. QD threshold at cellular/molecular level (Phycology-neuro function) (Liu et al. 2016; Sun et al. 2007; Chen et al. 2004; Page et al. 1999) is (0.80, 1.22): Choice reaction time (CRT).

This study has been approved by the Human Ethics Committee of Sports Scientific Research Institute of Hebei Province.

Results

Table 2 displays the overall physical function and QD threshold at body level of male participants. The male participant from CC and GL showed consistent balance ability, which was very significantly lower than the ability of male participants from HL. Although those from CC and HL showed difference in grip strength, it failed to reach significance level. As to sit and reach, GL has insignificant and significant difference compared with HL and CC, respectively. There was no difference in height, weight and BMI between cities.

Table 3 displays the overall physical function and QD threshold at body level of female participants. The balance ability of female participants is comparable with that of male participants. Significance level are more obvious between CC and HL than between CC and GL. Difference in SSEC between HL and GL is not significant. Similarly, there is no significant difference in SR between CC and GL as well as HL and GL. The female participants also showed difference in GS between CC and GL but without significance. Other indexes exhibited to be equivalent.

It can be seen from **Table 4** that the anthropometry, cardiovascular function, and lung function of male participants are equivalent. The STUA and STSC of this group showed to be highest in HL, followed by GL and lowest in CC. The STAB showed to be highest in HL, followed by CC and lowest in GL. Sebum content of male participants from HL is at the highest level compared to participants from the other two cities.

It can be seen from **Table 5** that anthropometry and cardiovascular function of female participants are equivalent. As to the lung function. The index of vital capacity exhibited significant difference between

Table 2: Overall physical function (Average ± SD) and QD at body level of male participants.

	CC	HL	GL	CC vs HL	CC vs GL	HL vs GL
Height (cm)	165.38 ± 5.39	168.39 ± 5.70	167.89 ± 5.35	0.037478 NS	0.031299 NS	0.0061789 NS
Weight (kg)	69.77 ± 10.05	71.22 ± 9.62	71.85 ± 9.23	0.04274 NS	0.06104 NS	0.01830 NS
BMI	25.46 ± 3.08	25.09 ± 2.97	25.48 ± 2.96	0.03042 NS	0.001632 NS	0.03205 NS
SR	3.24 ± 8.95	3.22 ± 8.95	2.84 ± 8.17	0.0129 NS	0.274 ★	0.261 NS
GS	36.99 ± 5.73	35.07 ± 7.96	35.56 ± 7.27	0.1108 NS	0.08192 NS	0.02883 NS
SSEC	7.19 ± 10.98	9.59 ± 8.44	7.51 ± 6.37	0.598 ★★	0.0905 NS	0.508 ★★

Note: QD: (0.27, 0.47). QD < 0.27 indicates no difference representing with NS; 0.27 ≤ QD < 0.47 indicates significant difference representing with ★; QD ≥ 0.47 indicates very significant difference representing with★★.

Table 3: Overall physical function (Average ± SD) and QD at body level of female participants.

	CC	HL	GL	CC vs HL	CC vs GL	HL vs GL
Height (cm)	153.70 ± 4.49	157.06 ± 5.23	156.87 ± 5.30	0.044934 NS	0.042419 NS	0.0025152 NS
Weight (kg)	62.23 ± 8.73	63.36 ± 8.25	62.97 ± 7.81	0.03739 NS	0.02456 NS	0.01283 NS
BMI	26.33 ± 3.40	25.69 ± 3.15	25.60 ± 3.08	0.05113 NS	0.05842 NS	0.007292 NS
SR	8.52 ± 7.71	8.60 ± 8.35	7.86 ± 7.34	0.0194 NS	0.168 NS	0.187 NS
GS	22.99 ± 3.12	22.39 ± 5.27	21.79 ± 5.76	0.05495 NS	0.1114 NS	0.05644 NS
SSEC	5.18 ± 4.53	6.95±5.90	6.34±5.38	0.611 ★★	0.420 ★	0.191 NS

Note: QD: (0.27, 0.47). QD < 0.27 indicates no difference representing with NS; 0.27 ≤ QD < 0.47 indicates significant difference representing with ★; QD ≥ 0.47 indicates very significant difference representing with★★.

Table 4: Organic function (Average ± SD) and QD at organic tissues level of male participants.

	CC	HL	GL	CC vs HL	CC vs GL	HL vs GL
Chest CIR (cm)	95.14 ± 5.27	95.90 ± 6.92	95.76 ± 6.45	0.01653 NS	0.0135 NS	0.003036 NS
Waist CIR (cm)	91.07 ± 8.36	91.11 ± 9.43	91.59 ± 8.87	0.0009124 NS	0.01183 NS	0.01092 NS
Hip CIR (cm)	98.88 ± 5.57	99.05 ± 7.00	98.82 ± 6.48	0.003569 NS	0.001261 NS	0.004831 NS
STUA (mm)	12.11 ± 4.96	14.14 ± 6.30	13.42 ± 6.25	0.322 NS	0.2134 NS	0.1086 NS
STSC (mm)	17.82 ± 6.67	19.70 ± 7.90	19.16 ± 7.15	0.2084 NS	0.1507 NS	0.05775 NS
STAB (mm)	24.09 ± 8.75	24.50 ± 9.72	22.40 ± 8.03	0.03507 NS	0.1511 NS	0.1862 NS
HR (times/ min)	79.13 ± 10.71	75.54 ± 9.50	75.70 ± 9.37	0.09647 NS	0.09208 NS	0.004396 NS
SP (mmHg)	130.52 ± 14.64	134.47 ± 16.40	132.27 ± 14.74	0.06195 NS	0.027674 NS	0.034276 NS
DP (mmHg)	82.57 ± 10.20	79.91 ± 10.74	83.21 ± 9.77	0.06804 NS	0.01604 NS	0.08408 NS
VC (ml)	2407.60 ± 653.92	2627.50 ± 695.86	2406.34 ± 681.49	0.181609 NS	0.00108771 NS	0.182697 NS

Note: QD: (0.47, 0.80). QD < 0.47indicates no difference representing with NS; 0.47 ≤ QD <0.80 indicates significant difference representing with ★; QD ≥ 0.80 indicates very significant difference representing with★★.

Table 5: Organic function (Average ± SD) and QD at organic tissues level of female participants.

	CC	HL	GL	CC vs HL	CC vs GL	HL vs GL
Chest CIR (cm)	91.63 ± 6.75	94.64 ± 7.65	94.20 ± 7.20	0.06716 NS	0.05748 NS	0.009683 NS
Waist CIR (cm)	90.70 ± 9.33	89.16 ± 9.66	88.56 ± 8.79	0.03558 NS	0.04961 NS	0.01403 NS
Hip CIR (cm)	99.23 ± 6.19	99.09 ± 6.78	99.05 ± 6.72	0.002934 NS	0.003773 NS	0.0008389 NS
STUA (mm)	22.46 ± 6.79	20.25 ± 6.98	18.28 ± 6.10	0.2152 NS	0.4279 NS	0.2127 NS
STSC (mm)	22.12 ± 7.24	21.79 ± 8.16	20.37 ± 6.71	0.03123 NS	0.1712 NS	0.1400 NS
STAB (mm)	29.73 ± 8.87	27.85 ± 9.80	25.75 ± 8.33	0.1357 NS	0.2986 NS	0.1629 NS
HR (times/ min)	78.61 ± 9.68	76.38 ± 9.31	76.08 ± 9.10	0.05980 NS	0.06797 NS	0.008177 NS
SP (mmHg)	125.01 ± 15.90	131.74 ± 17.34	131.84 ± 15.92	0.10896 NS	0.110532 NS	0.0015766 NS
DP (mmHg)	77.49 ± 9.93	77.35 ± 10.53	80.67 ± 9.69	0.003757 NS	0.08357 NS	0.08732 NS
VC (ml)	1507.94 ± 439.18	1967.01 ± 531.97	1617.97 ± 589.60	0.552230 ★	0.146338 NS	0.405892 NS

Note: QD: (0.47, 0.80). QD < 0.47indicates no difference representing with NS; 0.47 ≤ QD < 0.80 indicates significant difference representing with ★; QD ≥ 0.80 indicates very significant difference representing with★★.

CC and HL. The STUA, STSC, and STAB of this group showed consistent order as: highest in CC, followed by HL and lowest in GL. Sebum content of female participants from HL is at the highest level compared to participants from the other two cities.

Table 6: Phycology-neuro function (Average ± SD) and QD at cellular/molecular level of male participants.

	CC	HL	GL	CC vs HL	CC vs GL	HL vs GL
CFT (s)	0.76 ± 0.23	0.69 ± 0.24	0.70 ± 0.23	0.20 NS	0.17 NS	0.030 NS

Note: QD: (0.80, 1.22). QD < 0.80 indicates no difference representing with NS; 0.80 ≤ QD < 1.22 indicates significant difference representing with ★; QD ≥ 1.22 indicates very significant difference representing with ★★.

Table 7: Phycology-neuro function (Average ± SD) and QD at cellular/molecular level of female participants.

	CC	HL	GL	CC vs HL	CC vs GL	HL vs GL
CFT (s)	0.82 ± 0.25	0.73 ± 0.25	0.76 ± 0.27	0.24 NS	0.16 NS	0.084 NS

Note: QD: (0.80, 1.22). QD < 0.80 indicates no difference representing with NS; 0.80 ≤ QD < 1.22 indicates significant difference representing with ★; QD ≥ 1.22 indicates very significant difference representing with ★★.

As shown in **Tables 6** and **7**, there was no difference in CFT between different cities among both male and female participants. The index level showed same order as: highest in CC, followed by GL, and lowest in HL.

Discussion

Statistical analysis showed that the indexes of anthropometry and grip strength at body level, cardiovascular function at organic tissues level, and choice reaction time at cellular/molecular level were comparable without significance between cities with different economic development degrees. The BMI for both male and female exceeded normal standard, suggesting overweight trend among the elderly population in Hebei Province.

The effect of economic level is not significant on the ability of sit and reach. For both male and female from capital city, the performance in single-leg standing while eyes closed showed worst, indicating that the government of this city should take instructive actions to encourage the residents to participate in physical actives that aims to improve balance ability. The combined outcomes of the thickness of subcutaneous fat with the index of BMI indicates that elderly male from high level city and female from capital city should increase the intense and frequency of participating in physical actives to prevent various diseased due to high body fat percent. BMI is a reliable index reflecting body substantial (Wang et al. 2006), therefore, it is highly associated with obesity. Normally, BMI less than 18.5 is regarded as thin level, among 18.5–23.9 is regarded as healthy level, higher than 24 is regarded as overweight, and higher than 28 is regarded as obesity (Ministry of health of China 2009). Previous studies have evidenced that higher level of BMI may cause various chronic disease and is very likely to increasing the risk of cancer (Følling et al. 2014; Taghizadeh et al. 2015). Furthermore, the data also showed a higher BMI in elderly female than in male population, modestly, it can be speculated that the prevalence risk of cardiovascular disease such as hypertension, hyperlipidemia, diabetes, and coronary heart disease is higher among female population.

In general, there were no obvious differences in the indexes extracted from The National Physical Fitness Surveillance in Hebei province in 2014, which implies that the regional economic development is not a sensitive factor affecting physical fitness of elderly population. This means that the economic level failed to induce stress for elderly population in terms of the public physical health condition. According to the Arndt-Schulz law (Martius, 1923), with the amplified signal, the biological function increased gradually, and when it reaches to the peak, the plateau would arise, then decreased gradually. Moreover, the stable function during plateau is able to resistant the amplified signal, which demonstrates the existence of negative feedback mechanism in order to maintain function stability. The latter is called function-specific homeostasis, FSH (Liu et al. 2013). A function in and far from its FSH is called a "normal/dysfunctional function". In this study, the relationship between regional economic level and physical fitness condition could be expounded as that the simulation of improvement of economic level on the elderly health remains plateau.

The indexes collected from physical fitness testing directly explains the human health condition. As documented, anthropometry and fitness has been classified as normal-unnecessary function, while body function has been classified as key-unnecessary function (Liu et al. 2013). There was no significant difference in anthropometry between three regions, and QD presented uniform features at body function level and organic tissues level. This consistency demonstrated that it is anastomotic for the definition of the three levels of threshold in studies concerning human health function. However, the percentage of

antilog of the threshold with regard to 0.27, 0.47, 0.80, and 1.22 is 88%, 80%, 68%, 55.6%, respectively. It is clear that although the definition of threshold interval is sufficiently wide in the application of health-related research. For studies with different purpose, higher or lower order of magnitudes of threshold can be discussed.

There are limitations of this study. First, with data collected in one year, it is difficult to infer the trend of physical fitness condition of the population for a certain period. Liu et al. (Liu et al., 2013) analyzed data of physical examination collected repeatedly and calculated variation coefficient of health indexes to deduce the health condition of subjects. In order to make a further step for estimating the variation of physical fitness condition of elderly people during years, data collected in The National Physical Fitness Surveillance after the year of 2014 should also be analyzed. Second, this study only detected QD for average values, however, evaluation of QD for ratios of index level may contribute to expounding the boundary of health and sub-health as supplement, which is another worthy direction of further study.

Conclusions

For both male and female population, single-leg standing while eye closed exhibited favorable consequence among people from high level cities, indicating that attentions for improving balance ability of elderly people from general cities and capital city should be paid. The elderly female from capital city showed worst performance in vital capacity, suggesting that aerobic exercises may be targeted for them to improve the lung function. Regardless of gender, the elderly population presented consistent outcome of thickness of subcutaneous fat and choice reaction time, indicating similar status of phycology-neuro function. Although insignificant, the male elderly from high level cities and the female elderly from capital city should take more physical activities due to thicker subcutaneous fat.

Funding Information

This project was supported by Science And Technology Program of Hebei Province (172776185D) and General Administration of Sport of China, nationwide fitness research program (2015B094).

Competing Interests

The authors have no competing interests to declare.

References

Chen, Y., et al. (2004). Identification of hypoxia-regulated proteins in head and neck cancer by proteomic and tissue array profiling. *Cancer research, 64*, 7302–7310. DOI: https://doi.org/10.1158/0008-5472.CAN-04-0899

Cobb, J. P. (2010). MORE for multiple organ dysfunction syndrome: multiple organ reanimation, regeneration, and reprogramming. *Critical care medicine, 38*, 2242–2246. DOI: https://doi.org/10.1097/CCM.0b013e3181f26a63

Dai, Y. (2011). Investigation on the relationship between social economic development and physical change in Zhejiang province. *Unpublished thesis (PhD).* East China Normal University.

Fan, T., et al. (2012). A healthy ecological model for analysis of chronic diseases factors in the elderly. *Chinese General Practice, 1*, 33–36.

Følling, I. S., Kulseng, B., & **Helvik, A.-S.** (2014). Overweight, obesity and related conditions: a cross-sectional study of adult inpatients at a Norwegian Hospital. *BMC research notes, 7*, 115. DOI: https://doi.org/10.1186/1756-0500-7-115

General Administration of Sport of China. (2014). National bulletin of The National Physical Fitness Surveillance, 25 November 2015. Available at: http://www.sport.gov.cn/n16/n1077/n1422/7331093.html.

Jiang, W., et al. (1998). Investigation on regional characteristics and relavent factors of adult physical health condition in Jiangsu province. *Sports and Science, 5*, 126–133.

Jiang, W., et al. (2004). The influence of economic development on the national constitution in Jiangsu province. *Sports and Science, 25*, 47–48.

Krzysztoszek, J., Wierzejska, E., & **Zielińska, A.** (2015). Obesity. An analysis of epidemiological and prognostic research. *Archives of Medical Science: AMS, 11*, 24–33. DOI: https://doi.org/10.5114/aoms.2013.37343

Li, X. (2011). Comparative analysis of the physical constitution of China's elderly in 2000–2005. *Unpublished thesis (MS).* Taiyuan University of Technology.

Lin, C.-C., et al. (2014). Visit-to-visit variability of fasting plasma glucose as predictor of ischemic stroke: competing risk analysis in a national cohort of Taiwan Diabetes Study. *BMC medicine, 12*, 165. DOI: https://doi.org/10.1186/s12916-014-0165-7

Liu, C. (2013). Preliminary study on health engineering based on Pareto principle. *Journal of south China normal university: natural science edition, 45*, 148–154.

Liu, C. (2016). Quantitative difference and the application in sports science. *Journal of Physical Education, 1*, 11–17.

Liu, M. (2011). Analysis of health condition and influenced factors on the elderly in the third National Physical Fitness Surveillance in Linyi, Shandong province. *Unpublished thesis (MS).* Shandong Physical Education Institute.

Liu, T. C.-Y., et al. (2014). Action-dependent photobiomodulation on health, suboptimal health, and disease. *International Journal of Photoenergy*. DOI: https://doi.org/10.1155/2014/832706

Liu, T. C.-Y., et al. (2017). Quantitative Biology of Exercise-Induced Signal Transduction Pathways. *Oxygen Transport to Tissue*, 419–424. DOI: https://doi.org/10.1007/978-3-319-55231-6_54

Liu, T. C.-Y., Zhu, L., & **Yang, X.-B.** (2013). Photobiomodulation-mediated pathway diagnostics. *Journal of Innovative Optical Health Sciences, 6*, 1330001. DOI: https://doi.org/10.1142/S1793545813300012

Martius, F. (1923). Das Amdt-Schulz Grandgesetz. *Munch Med Wschr, 70*, 1005–1006.

Ministry of health of China. (2009). Health industry standards of the People's Republic of China WS_T312-2009, 01 April 2009. Available at: http://yiliao.kingdee.com/download/20131114141530_227505887.pdf.

Okafor, C., et al. (2014). Obesity, overweight, and underweight among urban Nigerians. *Nigerian journal of clinical practice, 17*, 743–749. DOI: https://doi.org/10.4103/1119-3077.144389

Page, M. J., et al. (1999). Proteomic definition of normal human luminal and myoepithelial breast cells purified from reduction mammoplasties. *Proceedings of the National Academy of Sciences, 96*, 12589–12594. DOI: https://doi.org/10.1073/pnas.96.22.12589

Pareto, V. (1971). Manual of political economy. Macmillan.

Sun, W., et al. (2007). Identification and characterization of novel activity-dependent transcription factors in rat cortical neurons. *Journal of neurochemistry, 100*(1), 269–278. DOI: https://doi.org/10.1111/j.1471-4159.2006.04214.x

Taghizadeh, N. (2015). BMI and lifetime changes in BMI and cancer mortality risk. *PLoS One*, *10*, e0125261. DOI: https://doi.org/10.1371/journal.pone.0125261

Villamor, E., et al. (2006). Trends in obesity, underweight, and wasting among women attending prenatal clinics in urban Tanzania, 1995–2004. *The American journal of clinical nutrition, 83*(6), 1387–1394.

Wang, X., Fand, L., & **Zhang, B.** (2006). Analysis and countermeasure of the difference between urban and rural residents in shandong province. *Journal of Shandong Physical Education Institute, 22*, 57–60.

Whitlook, M. C., & **Schluter, D.** (2015). The Analysis of Biological Data. *Colorado: Roverts and Company Publishers*, 176–177. Second Edition.

How to cite this article: Yuan, L., Jianzhong, C., Lijuan, L., Xiaofeng, J., Yan, Z., and Xiangang, Y. 2017 Quantitative Evaluation of Economic Level Effects on Physical Fitness Condition among Elderly Population in Hebei Province of China. *Physical Activity and Health,* 1(1), pp. 17–23, DOI: https://doi.org/10.5334/paah.6

Submitted: 11 November 2017 **Accepted:** 27 November 2017 **Published:** 07 December 2017

]u[*Physical Activity and Health* is a peer-reviewed open access journal published by Ubiquity Press.

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