**Exercise Science**

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| **Running title: Orthopedic Injury in Navy**Orthopedic Injury Epidemiology in Republic of Korea Navy PopulationGil-Dong Hong¹, Soon-Shin Lee²(Times New Roman 12 pt)¹*Department of Sports Science, Haengbog University, Seoul, Korea;* ²*Department of Health, Sarang Institute, Tokyo, Japan (Times New Roman 10pt)* |
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| **PURPOSE:** Although military personnels have been frequently having problems with musculoskeletal injuries, no epidemiological evidence exist from the military in Republic of Korea. The purpose of this investigation is to describe the musculoskeletal injuries epidemiology in the Department of Orthopedics in Marine Medical Center Republic of Korea Navy from 2015 to 2016 years. **METHODS:** Medical chart of hospitalized patients from January 1, 2015 to December 31, 2016 were reviewed. Musculoskeletal injuries were categorized by using International Classification of Disease 10th Revision. Descriptive statistics were reported. Chi-square test was used to analyze 1) the associations between the case of surgery and types of injuries, location of injuries, cause of injuries and preventable injuries 2) the association between preventable injuries and location and cause of injuries. **RESULTS:** Out of 741 patients, 125 patients were excluded from analysis due to improper injuries therefore 616 patients were analyzed. Acute injuries were 67.1% and chronic injuries were 32.9%. Sports activities were primary cause of injuries (39.8%) and work (27.9%) and physical training (21.1%) was followed. The most frequent anatomical location of injuries was knee (29.7%) and ankle (25.5%). Case of surgery was associated with acute injuries (chi-square=10.4, p=.001) and preventable injuries was associated with lower extremity injuries (chi-square=76.14, p<.05) and sports activities (chi-square=38.32, p<.05).**CONCLUSIONS:** Epidemiology data is the fundamental and essential information to develop injury prevention strategies to decrease injuries. The current investigation revealed that musculoskeletal injuries in knee and ankle joint were categorized as preventable and the injury prevention program may reduce the frequency of musculoskeletal injuries.  |
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| **Key Words:** Musculoskeletal, Injury, Epidemiology, Orthopedics, Navy |

INTRODUCTION (Times New Roman 12 pt)

 Aging of an individual can vary depending of various internal and external factors. Despite the rapid growth in field of science and technol­ogy, the exact mechanism of aging is still in the mist. More than 300 theories exist that explain the aging phenomenon with different perspec­tives [1,2]. Grossly viewed, there may be an infinite number of perspec­tives on aging since different species have different aging rates and pat­terns. For example, some specifies such as tortoise and many other rep­tiles decrease or remain the same as they age [2]. With humans, the mo­rality rate increases exponentially with increasing age. It has been a fun­damental quest for many scientists to deter or reverse the aging process for better longevity and extended life for centuries. However, despite the efforts invested in the quest for everlasting youth, aging still is a natural phenomenon that cannot be influenced by external manipulation. Al­though external manipulation may not alter the genetic composition and extend expected life span, influencing exogenous and endogenous factors to some extend may deter the expedited aging process up to cer­tain level. For example, free radical and reactive oxygen specifies (ROS) have been known to increase the damage biologically significant targets with oxidative stress for accelerated aging [3]. In addition, numerous tests are available to predict clinically problematic conditions to deter or eliminate further progression of the adverse conditions. Predicting the possibility of disease onset and progression has helped humans to live their expected lifespan to the fullest.

With different internal and external influencing factors for aging, a different concept of aging has been suggested to differentiate between the age calculated by the passing time and the age calculated by the dete­rioration rate of different sectors of human physiology. The age calculat­ed by the elapsed time since the birth is called the Chronological age (CA). CA merely informs the health status of the majority of population at certain stage in elapsed time. It does not inform specific state of an in­dividual. Although the normal developmental phases and rates can be calculated by simple mathematics, the rate of physiological decline can­not be clearly estimated by CA [4,5]. The physiological aging process is an individually uniquely process where multivariate factors influence the outcome. The concept of biological age (BA) was proposed to esti­mate the gradual functional and structural deterioration of an individual [5-7].

Numerous scientists have focused their research goal on estimating accurate BA for decades [6,8]. Several BA estimating models have been reported to estimate BA of individuals with various biomarkers. Since multivariate factors such as genetic, physiological, and psychological fac­tors may be involved in the aging process, different sets of biomarkers have been used to estimate BA [9-13]. A few groups of biomarkers with specific characteristics have been contemplated to represent the progres­sive state of individuals in comparison to their CA. The groups of bio­markers have been composed of either physical, biochemical, hormonal, or physiological parameters [4,14,15].

The biomarkers of BA have been selected based on the correlation with CA. Since the concept of BA was proposed to provide reliable esti­mation of deterioration in a general population, a set of biomarkers should change in function of CA. Although previous BA estimation models with specific groups of biomarkers showed correlation with CA, they could not present all corners of the deterioration state. Therefore, different sets of biomarkers seem necessary to represent the deterioration rate or BA of specific health state. As there is increasing evidence of bone health and aging, BA model should be based on osseous parameters. Bone loss with advancing age has been known to threaten loss of inde­pendence and health [16,17].

Materials and Methods (Times New Roman 12 pt)

1. Participants (Times New Roman 11 pt)

Data of a total of 4,644 eligible male participants (age\_30 years) from the fourth and fifth KNHANES which included the health behavior questionnaires, anthropometric, and osseous health measurements were utilized for the study. The fifth and fourth KNHANES assessment data of 2010 and 2008 were approved by the ethics committee of the Korea Centers for Disease Control and Prevention (IRB approval no: 2010-02 CON-21-C and 2008-04EXP-01-C).

**Table 1.** Subject characteristics

2. Statistical analysis (Times New Roman 11 pt)

Stratified cluster sampling and weighted values were applied to a na­tionally representative sample by the KHANES. The data were presented as mean±SD. In order to select the statistically significant biomarkers of aging, the Pearson correlation coefficient was calculated to examine the linear relationship between age and each parameter. Multiple regression models were used for building prediction models of BA. Variance infla­tion factors (VIF) which measure the impact of collinearity among the variables in a regression model were calculated for the selected biomark­ers prior to building the BA prediction model. The fitness of the model was analyzed by calculating coefficient of determination (R2). All statisti­cal data analyses were performed using the Statistical Package for the Social Sciences SPSS 20.0 software. In order to observe the statistically significant difference between BA and CA, one-way analysis of variance (ANOVA) was conducted and followed by for Bonferroni post-hoc anal­ysis. Statistical significance was obtainedif *p*<.05.

**Table 2.** Subject characteristics

Results (Times New Roman 12 pt)

1. Construction of the prediction models (Times New Roman 11 pt)

Principal component analysis (PCA) is a popular BA estimation algo­rithm which determines a covariant structure through an orthogonal transformation. The PCA statistical method incorporates multiple linear regression approach to form a single estimation algorithm [4,13,19]. The PCA method combined all parameters to form one principal compo­ nent with eigenvalue and percent variation of 3.21 and 64.19%, respec­tively. The principal component and the candidate biomarkers were test­ed for their stability by loading and unloading the CA values to the analysis. After testing for the stability, the BA scores were calculated. The BA scores were obtained through the multiple linear regression analysis between the first principal components and the biomarkers. The BA scores were then modified to represent the scores similar to that of CA by adding the CA values into the formula [4,26]. The initial formula was further modified by adjusting for the under- and over-estimated BAs. Ages of some individuals have been reported to deviate from the mean of the population due systemic errors [9,25]. Such systemic errors were corrected by adding z scores (difference between the individual CA and the mean CA multiplied by 1 minus b) to the BA values. Following BA prediction model was derived after the final adjustment.

Discussion (Times New Roman 12 pt)

Cells in human body are genetically programmed for uniquely specif­ic life spans. Such specific life spans can also be influenced by both avoidable and unavoidable external factors. Therefore, it may be difficult to develop a universally fitting BA prediction model that could estimate BA for all health conditions. Different BA estimation models with uniquely specific biomarkers may be needed to predict more specific BAs of different physiological health. However, a common goal of the BA prediction models would be to elucidate the rate of deterioration for an individual. Currently, the best suggested way is to compare such de­terring rates with normal individuals within a genetically homogeneous population using a specific prediction model for particular state of health. Therefore, this study obtained osseous biomarkers from a repre­sentative group of Korean male population to develop a BA prediction model. Five osseous biomarkers were selected through a thorough parsi­monious step-by-step exclusion and inclusion criteria process. Each bio­marker was bone mineral density (BMD) derived from different parts of the body: arm, leg, spine, pelvic, and hip (ward’s triangle). Developed os­seous biomarker based BA (equation 1) was tested for its applicability with two different state of heath: fall experience and continuous walking duration.

Conclusion (Times New Roman 12 pt)

A battery composed of five osseous parameters or biomarkers was ob­tained through thoroughly conducted exclusion and inclusion proce­dure. These biomarkers went through several statistical steps to for a BA prediction model for bone health assessment. This non-invasive BA pre­diction model may be used as a guidance tool in a health related center to address and advocate bone health on an individual based. Developed BA model was tested for its applicability in two different bone related problems: fall history and walking duration. Both tests indicated that fall history and sedentary life style were all effective in increasing BA espe­cially for the older group. Therefore, osseous parameters may be used to inform bone health status.

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Conflict interest (required)

이 논문 작성에 있어서 어떠한 조직으로부터 재정을 포함한 일체의 지원을 받지 않았으며, 논문에 영향을 미칠 수 있는 어떠한 관계도 없음을 밝힌다.

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[Figure] - ppt, jpg 형식



[Table]

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| Variab**l**es | n | Mean±SD | Range |
| Age (years) | 121 | 31.1±3.2 | 21.0∼39.0 |
| Height (cm) | 120 | 162.3±4.5 | 150.0∼173.0 |
| Hip circumstance (cm) | 61 | 97.6±5.4 | 84.0∼111.0 |
| Prepregnancy Weight (kg)∬ | 119 | 53.9±6.9 | 40.0∼88.0 |
| Postpregnancy weight (kg) | 119 | 64.1±7.7 | 42.0∼89.0 |
| BMI (kg/m2) | 118 | 24.3±2.8 | 17.6∼34.8 |
| Values are means and SD. ∬postpregnancy weight= body weight between from 34 to 36 weeks into pregnancy |