# INCIDENCE OF PHYSICAL ACTIVITY HABITS IN PLASMA LEVELS OF HEAT SHOCK PROTEINS IN A HEALTHY POPULATION SAMPLE

EXERCISE AND SPORTS MEDICINE CLINIC

ORIGINAL ARTICLE

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## ABSTRACT

Introduction and objective: The relationship between heat shock proteins (HSP) and physical activity habits has not been studied in depth, which raises the question about the role these proteins play in health. Based on this uncertainty, this study aims to determine whether plasma levels of these proteins are modified according to physical activity habits. Method: Twenty-four blood samples were taken to study HSP concentrations, by ELISA test, and International Physical Activity Questionnaire (IPAQ) was applied to determine physical activity habits. In statistical analysis, were compared HSP means (categorical variables), using ANOVA. Correlation (Spearman) was studied for continuous variables; moreover a multiple linear regression was developed in order to establish the effect of each one of the independent variables In HSP concentrations. Results: For studied sample, not statistically significant differences were found in concentrations of HSP, between active and sedentary subjects; however it was observed that as individuals become more active, levels of HSP are reduced. The correlation between energy expense and concentrations of HSP was not found. In male population, significant differences in concentrations of HSP between categories of physical activity habits (measured in three categories) were found. Conclusion: We propose to keep investigating, since the study suggests that regular practice of physical activity, acts as a protective factor reducing levels of these kinds of proteins in blood.

**Keywords:** health, exercise, heat-shock.

## INTRODUCTION

Historically, regular practice of physical activity has had a remarkable evolution. Along of time, the role of physical activity has been changing. Since twentieth century, emphasis has been mainly set in the technological transformation of industry; thus, which has provoked that energy expenditure of workers has been tremendously reduced. This technological transformation has been increasingly present; nowadays all families have many appliances which substitute human work. This is how physical demand of daily activities has been significantly reduced due to modernity, either at work or in activities of daily living. Moreover, working hours have been reduced, which resulted in more free time for other activities. Unfortunately, this free time is dedicated to activities which are mostly sedentary[1].

Epidemiological studies found that more than half of the adults in developed countries are not sufficiently active to be considered healthy, fact which is more remarkable in countries under development, according to the World Health Organization (WHO). It was also estimated that the proportion of sedentary adults in the world is located between 60 and 85%[2].

Considering the mentioned epidemiological situation, we should emphasize the requirement to promote healthier lifestyles and encourage the practice of regular physical activity, to consequently reduce diseases and have a healthier population with better quality of life. Moreover, it is known that physical activity at certain intensity generates physiological stress situations which may cause expression of certain proteins, better known as "stress proteins or heat shock proteins" (HSP), which are a set of proteins with specific characteristics, generally induced by environmental or physiological stress, which have been studied in the last years, due to the role they play as health indicators[3-5]. These proteins provide important signs on the condition of certain diseases, being an indication that the body is acting to protect itself from any situation, usually harmful. One of the situations which increases the expression of these proteins is physical activity and/or exercise. Previous studies have demonstrated increase of HSP after intense physical exertion[6,7]. However there is still a gap about resting conditions and concerning daily habits of physical activities since it is considered that heavy exercise increases the levels of HSP; then it is possible to assume that trained individuals would present higher levels of these proteins. Therefore, from the point of view that states that active individuals present lower risk for many diseases, it can be concluded that their Hsp would be lower; however this query still remains.

Consequently, in order to determine if regular practice of physical activity affects the HSP70 concentrations in serum, IPAQ was applied to studied individuals in order to estimate habits of physical activity. Additionally, blood samples were collect-

ed through ELISA test to determine serum levels of HSP70, to subsequently accept or reject the hypothesis proposed in the study: "there are significant differences in serum levels of HSP70 between active and sedentary subjects".

## METHODS

### Sample

Twenty-four healthy university students from Pharmacy School of University of Granada, Spain, who voluntarily gave written informed consent, in which is exposed the will to give 5 mL of blood, and who correctly answered the questionnaire of physical activities habits.

Blood samples were collected by Blood Bank's team of from Andalusian Health Service (SAS), dependant on the "*Junta de Andalucía*" of Granada city, in Pharmacy School of University of Granada. The Blood Bank service was for free, and only had time imposition, which limited the size of the resulting sample.

Of individuals, 50% (12 individuals) were female, while the rest 50% were male.

Minimal age was 18 and maximum 58 years. Mean was of 23.5 years and mode 18 years, with a standard deviation of 10.3 years.

Participants filled out a form with personal information (sex, age etc).

Meanwhile, for the present study, information about habits of physical activity, was derived by the application of the International Physical Activity Questionnaire (IPAQ), which considers the habits that subjects have experienced in the last week before the questionnaire application[8,9]. In order to obtain information about serum levels of HSP70, blood samples of about 5 mL were collected and these proteins were determined through ELISA test.

### Samples treatment

Blood samples were treated in Laboratory of Department of Preventive Medicine and Public Health in Pharmacy School of University of Granada, where specialized technicians performed all the procedures related to the implementation of the ELISA test.

### Statistical analysis

For each studied variable was performed a descriptive study of statistic measures of central tendency, such as quartiles, mean, mode, standard deviation, etc. An analytical study was performed, studying the correlation between variables (Spearman) mean were compared (ANOVA) and a multiple linear regression model was developed to determine the effect of each independent variable on the dependent variables. For data analysis used SPSS program, version 15.0.

## RESULTS

### Habits of daily physical activities

70.8% of individuals (17 subjects) are sedentary, while 29.2% (7 individuals) are active (table 1). The number of active individuals in each gender was evaluated; results prove that men are more active than women and that there are as many active as sedentary individuals both genders; only one studied woman is active, whilst 11 are sedentary.

According to habits of physical activity classified in three levels, 16.7% of individuals (4 subjects) were situated in category 1 (most sedentary), whilst 13 subjects (54.2%) in category 2 and 29.2% of individuals (7 subjects) are classified in category 3 (most active) (table 2).

Physical activity was quantitatively measured through weekly energy expenditure and the mean obtained was 2,196.6 METs per minute in a week, mode was 1,386 METs per minute and standard deviation was 1,372.3 METs*min. The differences between genders are statistically significant (p = 0.017), men practice more physical activity (mean 2,844.3 METs per minute per week), while weekly mean expenditure for women was 1,548.8 METs per minute (table 3).

**Table 1.** Habits of physical activity (two categories).

| Habits of physical activity | Frequency | Percentage | Accumulated percentage |
|---|---|---|---|
| Sedentary | 17 | 70.8% | 70.8% |
| Active | 7 | 29.2% | 100% |
| Total | 24 | 100% | |

**Table 2.** Habits of physical activity (three categories).

| | Frequency | Percentage | Accumulated percentage |
|---|---|---|---|
| Category 1 | 4 | 16.7% | 16.7% |
| Category 2 | 13 | 54.2% | 70.8% |
| Category 3 | 7 | 29.2% | 100% |
| Total | 24 | 100% | |

**Table 3.** Comparison between energy expenditure between sexes.

| Gender | Weekly mean (METs/min) | N | Standard deviation (METs/min/w) | Significance (p) |
|---|---|---|---|---|
| Women | 1.548.8 | 12 | 1.071.2 | 0.017 |
| Men | 2.844.3 | 12 | 1.369.1 | |

### HSP70 concentrations

Concerning to HSP70 concentrations, it is observed that mean is 819.4 ng/ml, with a minimum value of 12.2 ng/ml and a maximum of 6,544.7 ng/ml. Standard deviation is situated in 1,798.1 ng/ml.

Regarding to gender differences in HSP70 concentrations, the values are not significantly different between sexes (p = 0.884), according to comparison of means analysis (table 4).

Table 4. Mean Hsp70 and gender comparison.

| Gender | N | Mean Hsp70 (ng/ml) | Standard devation (ng/ml) | Significance (p) |
|---|---|---|---|---|
| Women | 12 | 875.0 | 1.869.4 | 0.884 |
| Men | 12 | 763.9 | 1.805.1 | |

### Habits of daily physical activity

The results of comparison analysis of the means of the habits of physical activities (classified in actives and sedentaries) and HSP70, show that the differences are not statistically significant ($p = 0.394$). Separated by sex, men ($p = 0.462$) and women ($p = 0.683$) presented not significant differences between sedentary and active individuals for the means of HSP70.

When habits of physical activity are compared in three categories, the results show that the differences in Hsp concentration are not statistically significant ($p = 0.304$). Comparing the same three categories separately per sex, the results show that in women differences between the means of Hsp70 concentrations are not statistically significant ($p = 0.877$); conversely men present statistically significant differences ($p < 0.01$) (table 5).

The correlation (rho by Spearman) between energy expenditure (quantitative physical activity) and HSP70 concentrations was studied and is not statistically significant ($p = 0.346$, $r = –0.201$). No correlation was established for genders (women: $p = 0.646$; $r = 0.148$. men: $p = 0.762$; $r = 0.098$).

Table 5. Comparison of means HSP70 and physical activity habits.

| A. Physics 1, 2 or 3 Men | Average Hsp70 (ng/ml) | N | Standard devation (ng/ml) | Significance (p) |
|---|---|---|---|---|
| Category 1 | 6.341.5 | 1 | – | *0.000 |
| Category 2 | 135.6w | 5 | 223.7 | |
| Category 3 | 357.9 | 6 | 560.4 | |

### Multiple linear regression model

The model was developed with three variables: age, physical activity in three categories and heavy intensity energy expenditure in, where the global test presented significance signs ($p = 0.087$). When variables included in the model were analyzed, it was verified that association is significant for age ($p = 0.046$) and physical activity in three categories ($p = 0.019$); whilst, significance inklings were found for energy expenditure in heavy intensity activities ($p = 0.064$).

## DISCUSSION

The present study demonstrates that men significantly perform more physical activity than women, when physical activity is quantitatively measured (METs/minute per week). Concerning to gender comparison, serum levels of HSP70 did not present statistically significant differences between men and women ($p = 0.88$), however the mean values for women were higher than the ones for the men, which corroborates what has been described by other authors, although differences in those studies reached the statistical significance[10].

There are significant evidences that HSP70 concentrations depend on age, physical activity in three categories and energy expenditure in heavy intensity activities, when these three variables act together.

There were not statistically significant differences for HSP70 concentrations, when comparing sedentary and active individuals, which contradicts the statement of Banfi[6], in which athletes presented higher levels of HSP70 than non-athletes. The statistical significance was not reached at comparing Hsp concentrations between three levels of physical activity habits, with the entire sample. However, when is considered only male population the statistical significance is achieved ($p < 0.01$). It should be observed that there is a strong tendency that suggests that HSP70 concentrations are reduced when habits of physical activity become more active (when physical activity is measured in three categories and also comparing between active and sedentary subjects). There is also consistency when physical activity is quantitatively measured; although the correlation is not statistically significant, it is clearly negative, which means that as energy expenditure increases, HSP70 concentrations are reduced.

This research opens an interesting investigation approach in which regular physical activity practice may act as an instrument for health promotion, since this practice is able to reduce serum levels of HSP70, which are considered sign of disease.

## CONCLUSION

This study answers some raised issues, clarifying some points; however, the sample of the study is too small, statistically speaking, which may have influenced not to achieve the statistical significance. Thus, we suggest that other researchers follow this approach in order to further study this issue, using more representative samples, in an attempt to clarify the question and optimistically end with the uncertainty that still exists.

## ACKNOWLEDGEMENTS

To César Criado for his valuable work in the laboratory. We also thank the doctors and nurses from the Blood Bank of city of Granada. Finally, to the people who donated blood, without them it would have been impossible to conclude this work.

All authors have declared there is not any potential conflict of interests concerning this article.

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