Metabolic And Cardiovascular Assessment At High

School, An Italian Experience - The Maciste Study

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Introduction

The MACISTE (Metabolic And Cardiovascular Investigation at School, TErni) is a population-based observational study conducted in subjects attending a high school in Terni, Umbria – Italy. The study aims to collect a large dataset of information describing the metabolic and cardiovascular behavior of a population of adolescents. There is a large body of evidence linking the presence of cardiovascular risk factors in early adulthood and the occurrence of cardiovascular morbidity and mortality in later life. However, less is known about the relationship between traditional and newer cardiovascular risk factors with early signs of organ damage in childhood and adolescence. Specifically, less studies have evaluated the relationship between cardiovascular and metabolic findings and the presence of early vascular damage, such as segmental and local arterial stiffening, intima-media thickness and arterial distensibility. Preliminary results from large prospective studies, such as the Young Finns Study¹, suggest the existence of an association between levels of physical activity and carotid elasticity later in life, and other reports seems to confirm such association².

However, the complex relationship between the cardiac and vascular function at this age level remain largely unexplored. The **MACISTE study** aims to collect a large amount of biochemical, anthropometric, metabolic and cardiovascular data, along with personal details collected by self-administered questionnaire, in order to account for all the factors involved in the process of physiological and pathophysiological cardiovascular function in adolescence. Voluntary participants were asked to undergo a series of laboratory, instrumental and functional tests, such as lipid and glucose profile, assessment of fat mass degree and distribution, information about salt consumption, maximal strength, echocardiographic and vascular imaging. The measurements will form a basis for further follow-up studies in which risk factors of cardiovascular disease will be studied. The results will be also useful to inform the best choices at the educational level in order to promote health habits at a high school behavior.

Research

Equipment for measurement have been prepared and performed at the "Liceo Donatelli" high school premises located in Terni, Umbria, Italy in a quiet place and after an overnight fasting. Doppler Ultrasound of the supraaortic vessels was performed after refraining from smoking, tea and coffee consumption, and physical activity. Blood and urine samples were drawn and analyzed at the Central Laboratories of the Terni University Hospital. A well-trained operator (F.B.) collected ultrasound images in both left and right carotid arteries. This resulted in a video-clip with a length of at least 10 heartbeats. Video clips were stored into external hard-disk devices and made available for offline



analysis. Volunteers were subsequently subjected to echocardiography, bioimpedance analysis, measurement of aortic

pulse wave velocity, indexes of wave reflection and central blood pressure. A sub-group of volunteers underwent 40% maximal handgrip effort through fatigue, and cardiac and carotid measurements were repeated just before maximal fatigue in order to analyze functional changes induced by acute isometric stress. A self-administered questionnaire explored the personal and familiar habits potentially related to cardiovascular health, such as overweight, caloric intake, personal and parental smoking habits, and disturbance in quality of sleeping. Multivariate statistical models were employed to detect the independent relationship between metabolic and cardiovascular findings.

Challenge

The purpose and main objectives of our research well fitted with the need to analyze the largest population in the smaller possible time for each evaluated subject. To accomplish this, in addition to an efficient organization of the team that carried out the protocol measurements, it was necessary to rely to **high-impact** and **easy-to-use** technologies, that would make available image analysis and the integration of multiple information in an offline mode.

One of the greatest challenges was to evaluate the local carotid stiffness by using combined technologies for the evaluation of carotid distensibility and non-invasive measurement of carotid central blood pressure with dedicated devices.

Cardiovascular Suite

Cardiovascular suite gave us actually what we needed: the opportunity to measure IMT, carotid distensibility and Young elastic modulus in an offline modality. The images were reviewed by expert sonographers in our research center, and the results were combined with data from peripheral blood pressure and radial and brachial applanation tonometry. The offline analyses works on a quite high speed, which makes it easy in use and gives us the relevant outcomes instantly. Moreover Cardiovascular Suite gives us the opportunity to delete some parts of the video clip of which were not suitable for analyses. The quality of results was continuously monitored.





Conclusion

In conclusion, the **Cardiovascular Suite** enabled the evaluation of carotid dimensions, IMT and measures of local carotid stiffness in the **MACISTE Study** with high standards of quality. Results With these results we will be able to describe the relationship between such parameters and a number of biological and anthropometric variables, along with personal data such as food and physical habits of adolescents. These results will be aiming at preventing the occurrence of cardiovascular damage at a very early stage of its development.

Quipu and Cardiovascular Suite



Quipu srl is a spin-off company of the Italian National Research Council and the University of Pisa, Italy. The mission of Quipu is to provide products and services in high-tech diagnostic and preventive medicine. In particular, the core business is the development and production of systems and techniques for assessing early markers of cardiovascular risk. Quipu's main product is Cardiovascular Suite, which is a software program for assessing markers of cardiovascular risk from ultrasound images. The suite consists of two applications: (i) FMD Studio, for assessment of endothelial function; (ii) Carotid Studio, for assessment of carotid stiffness and intima media thickness. The advantages of the Suite are: high reliability and accuracy, high integration, ease of use, realtime processing. Furthermore Quipu offers consultation services, image reading services and training programs.

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