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Articles and Statements

The Implications of Synchronization in Biomechanics S.N. Habibza, M.A. Chen, I.R. Spear	3
Monitoring and Evaluation Component of Test Control System in Physical Education of Students with Chronic Health Conditions V. Koryahin, O. Blavt, O. Stetsyak	11
The Efficiency of the Professionally Applied Physical Preparation of Students with Diseases of the Nervous System V. Koryahin, O. Blavt, T. Gurtova	18
An Exploratory Study of Collegiate Track and Field Athletes' Participation Motivations and Health Related Behaviors H.Z. Zeng, Y.W. Yang	28

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Articles and Statements

The Implications of Synchronization in Biomechanics

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Abstract

Spatial synchronous of video-derived kinematic (2D or 3D) and kinetic (i.e. EMG or force plate) acquisition routinely allows a simultaneous collection of coordinated biomechanical dynamic configurations from human movements. Synchronization technic could assist to identify the differences between modes of walking. Use of synchronize technologies differentiated abnormal and pathological gait patterns in clinical setting. Synchronization technic could also assist to greater understanding of areas of muscle weakness, potential stresses and injuries in variety of individual in different conditions. Simultaneous kinematic and kinetic measures could contribute to design rehabilitation program to optimum functional recovery. Likewise, the use of coordinated kinematic and kinetic biomechanical features could address individuals' adaptability to sport facilities to optimal physical performances or pattern modifications paradigms. It seems, practicing synchronizing approaches will benefit diverse sporting and clinical sectors in board ranges and frequent utilizations of this technology for more biomechanical discovery are warranted.

Keywords: biomechanics, synchronization, kinematic, kinetic.

1. Introduction

Synchronization in Biomechanics

Synchronization in biomechanics studies routinely permits a simultaneous collection of coordinated biomechanical data using video-based kinematic variables from human movement and digitized records of analog data like electromyographic (EMG) signals and force platform signals from body muscles at the same time that enables multiple measurements to characterize large quantities of biomechanical features in vary of human activities (Komisar et al., 2017; Abraham, Kalakanis, 1993). Spatial synchronous of video-derived kinematic (2D or 3D) and kinetic (i.e. EMG or force plate) acquisition such as gait analysis in sportic research and therapeutics program are come practice (Olenšek, Matjačić , 2012; Glass , 2001; Yen and Radwin ,1995) (Figure 1).

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Fig 1. Coordinated kinetic and kinematic variables

Use of synchronize technologies can help to develop better understanding of the mechanism that is behind daily perplexing phenomenon to prime walking rhythm or pattern in different individual (Zivotofsky, Hausdorff, 2007). On this premise, synchronization technics could assist to identify the differences between forward and backward walking to improve the effectiveness of the therapeutic intervention.

2. Discussion

Regarding to this, Sun and colleges (2018) recently have provided remarkable guidance for intervention campaigns to improve walking gait performances using foot inter-segment kinematics and kinetics associated with walking speed. Normative foot 3D kinematic and force plate (or kinetic appliance) synchronized feature variables in this research showed GRFs significantly increased with walking speed and peak values of the knee and ankle moments in the sagittal and frontal planes during forward walking (FW) in comparison with slow walking (SW) and normal walking (NW). Following this, Sun et al., (2018) stressed this outcome could be set as a reference to distinguish abnormal and pathological gait patterns in clinical setting. Similarly, Itoh and colleges (2015) in a supplement reported selected integrated of 3D kinematic and kinetic features during forward and backward walking in gait initiation elicited GRF and step length were less in backward walking than forward walking whilst backward walking generated more force than forward walking that can be beneficial at balance exercise in rehab managements.

Additional weight system on body during different walking patterns may help individual with movement disorder .On this basis, Patiño and colleagues (2007) examined the kinematic, kinetic and electromyographic characteristics of young adults ' walking on a fixed platform without a vest and with partial body weight support (PBWS) of 0, 10, 20 and 30 %. They observed significant differences in spatial-temporal variables, the maximum and minimum angles for the thigh, knee, and ankle, and the amplitudes of the anteroposterior horizontal and vertical GRF components with greatest changes in part at PBWS of 30 %.

More importantly, synchronize acquisition of different digitized implications can also aid to greater understanding of areas of muscle weakness, potential stresses and injuries to promote performances in recreational and competitive sports (Vladimir, Marian, 2015; Kovacs, Ellenbecker, 2011).

For instance, Revak and colleagues (2017) evaluated to assignee Achilles tendon loading during heel-raising and-lowering exercises in healthy men. Subsequently, processing of integrated 3D kinematic motion capture and force plate data which processed using a lower – extremity –

musculoskeletal model showed Achilles tendon peak stress, force, and strain were lowest during the Seated exercise and were highest during the Unilateral exercise . Alternatively, Bilateral and seated heel – raising and – lowering exercises resulted in less Achilles tendon loading. Consequently, the author of this study suggested that bilateral exercises with less body weight could be desirable in earlier rehabilitation process, whereas unilateral exercise may be more useful in later exercise progressions.

To intensify athletic performances, countermovement jumps that is loaded with a weighted vest often use to enhance lower body power to improve jump performance. In accordance to this, Janssen et al., (2012) investigation was set to determine how lower extremity kinematics and kinetics affected by loaded jumps during landing in sports such as volleyball. Subsequently, simultaneous integrated kinematic and kinetic landing components in this study showed hip flexion were significantly greater in the unloaded condition and there was no significant difference in any other kinematic or kinetic variables. In addition, the outcome of this study supported the fact that loaded block jump trainings can help to improve jumping performance.

Malfait et al. (2016) by using a model of coordinated knee and hip kinetic (EMG and force plate) and 3Dkinematic of video analysis recordings could clearly predict the quadriceps and hamstring neuromuscular activations pattern in drop jump landing. They revealed an erect landing pattern that was characterized by less hip and knee flexion and was accompanied with an increased medial and posterior neuromuscular activation of dominant hamstrings medialis activity during the preparatory and initial contact phase and an increased lateral neuromuscular activation of dominant vastus lateralis activity during the peak loading phase. They subsequently suggested more investigations are specifically required to determine the neuromuscular landing pattern that is related to higher ACL injury risk.

Proximal hip control may influence the loading on the knee and the incidence of the anterior cruciate ligament (ACL) injury in cutting and jumping in athletic sports in both sexes. Relatively, Pollard and colleagues (2007) using synchronized hip joint 3Dkinematic and force plate measures, stated female athletes demonstrated greater hip internal rotation and used less sagittal plane hip motion compared to the male athlete in cutting maneuver. They further pointed out these differences in hip proximal control strategies that exhibited by female athletes might be due to the weaker musculature type in female athletes.

Mkaouer and colleagues (2013) using a force plate that was synchronized with a two dimensional(2D) movement analysis system assessed the take-off kinetic and kinematic variables during two types of acrobatic gymnastics while performing the backward stretched somersault. They stated backswing connections were different in the take-off angle, linear momentum, vertical velocity and horizontal and vertical displacements. More importantly, they indicated higher elevation of the center of mass in the flight phase would allow best performance with lower the risk of falls, in part when could combined to a great angular momentum by a gymnast.

Lin and Karduna (2016) using coordinated 2D kinematic and EMG data in another study stated that four-weeks strengthening exercise program enhanced the strength of rotator calf muscles in exercise group compared to the control group in healthy individual. However, the exercise protocols did not completely change rotator calf muscles EMG patterns and scapular kinematics in training group in comparison with those control counterparts.

Dwyer and colleagues (2010) by simultaneous comparison of lower extremity 3D kinematics and hip muscle activation electromyographic (EMG) during closed kinetic chain (CKC) exercises (single-leg squat, lunge, and step-up-and-over) could differentiate the performed tasks between sexes that could serve during rehabilitation programs. Correspondingly, they reported the sex differences during each tasks particularly observed in sagittal-plane movement patterns. They in more details explained women had smaller degrees of knee flexion and larger degrees of hip extension angles in comparison with men across all exercises. Women also, demonstrated higher activation levels of the rectus femoris and gluteus maximus muscles during CKC tasks compared with men. Nevertheless, men exhibited larger degrees of hip flexion during the single-leg squat compared to the women.

Likewise, Momeni and colleagues (2014) utilized a synchronized model of 3D motion capture and EMG during semi-reclined cycling at different workloads in healthy individual to design better exercise regimen for older adults and to develop more effective rehabilitation strategies for individual who are in need. Subsequently, they stated muscles activity patents and their co-activations (i.e, RF & BF) that were significantly affected with changing cycling workloads in healthy participants, which is an important consideration during cycling exercise in particular for elderly and individual with compromised musculoskeletal systems.

Elsewhere , an integrated kinematic and kinetic study of netball shoulder pass by Hetherington and colleagues (2009) divided the associated skills into comprehensive phases of analysis that allowed more accurate observation of errors while skill execution . In this study, the implementation of a video and force platform at the same time in this study showed greater deceleration torque of the arm than acceleration in the upper limb after the propulsion phase. Peak ground reaction force of 850 N in the frontal (Fz) direction was found to coincide with the point of maximum velocity of the participant's COP occurred in 40 ms and before ball release during wind up and propulsion phases.

Sekiya and Takahashi (2003) also described the most effective mechanical pattern of rolling motion using synchronized 3D kinematic system and force platform in normal adults as a useful guide for treatments of individual with neurological dysfunctions. They revealed hip abduction-adduction angle was almost natural and remained constant during rolling motion .They further stated the hip rotation angel was at a neutral with a slight internal rotation at the beginning and then linearly rotated toward the end in rolling motion.

In addition, different designs of simultaneous integrated kinematic and kinetic features can contribute to design rehabilitation program to optimum functional recovery at desirable levels of physical activity in particular sportic activities or in rehabilitation practices (Suputtitada, 2017; Borzikov et al., 2015).

To give an instance, Risberg and colleagues (2009) designed a neuromuscular and strength exercises project to restore the patients' dynamic knee stability in order to return to the jumping activities in competitor with ACL injuries. Correspondingly, coordinated model of the 3D kinematic and force plates data, that processed using a 3D visual inverse-dynamic software, showed some improvements in knee extension moment after walking intervention, but not after hopping since longer rehabilitation period was required to full recovery after ACL injury.

Likewise, shoulder kinematic and kinetic of wheelchair biomechanical loads and posture configurations could help clinicians and therapists to optimize the wheelchair setup and to avoid injuries in wheelchair users during wheelchair propulsion. Correspondingly, Koontz and colleagues (2002) using 3D shoulder invers – dynamic upper limb model that was included of 3D motion capture and force plate revealed peak shoulder posterior forces occurred near the end of the propulsion phase, which was along with simultaneous maximal shoulder flexion and minimal shoulder abduction during wheelchair propulsion. More subsequent coordinated data showed the shoulder range of motion (ROM) was vary at different speed in wheelchair users.

Elsewhere, Lerner and colleagues (2017) utilizing the synchronized technique evaluated the effects of a robotic exoskeleton that could provide knee extensor assistance on lower limb joint mechanics during treadmill walking in children with crouch gait from Cerebral Palsy (CP). The coordinated 3Dkinematic, and force plate and EMG data that processed using an inverse dynamic model in this investigation showed knee extension assistance improved posture knee kinematic but without any changes in knee moments. The knee extension assistance also improved the function at the hip, but not at the ankle in individuals with gait-deficits indicating that further investigation are warranted.

More empirical evidence by Murgia and colleagues (2015) unveiled that biomechanical integrated technologies of kinematic and kinetic variables could aid to improve the associated – gait – disturbances movements in patients with Parkinson's disease . Similarly, Kertis and colleagues (2016) stated simultaneous 3D Kinematic and kinetic assessments clinically could be a beneficial assessments in individual with osteogenesis Imperfecta (01) who experience ambulatory and upper limbs challenges .

More recently Christensenet and colleagues (2018) using a model of coordinated kinematic and kinetic configuration evaluated the positive benefit of resistance eccentric movement pattern in patients following total knee arthroplasty (TKA). Synchronization of 3D kinematic and force plate figures in this study elicited resistance eccentrically biased movements compared with resistance concentrically movements produced higher levels of extensor angular impulse on the surgical limb in patients after TKA in rehabilitation setting. Indeed, biomechanical analysis of synchronized kinematic and kinetic configuration frequently is utilized to contribute in in clinical gait assessments and to design of various clinical intervention protocols for optimum functional recovery after stroke.

For instance, Mao and colleagues (2018)'s observation of integrated 3D kinematic and force plate alerted variables in subacute stroke survivors during Sit-to-Stand (STS) tasks showed the total time of STS task owing to the lower knee moment, abnormal timing point and lower GRF was significantly longer in people with subacute stroke compared to the healthy controls. Similarly, Millington and colleagues (1992) using a modulated synchronization of 2D kinematic and force plate, and electromyographic data in a same application successfully characterized onset areas of difficulties (i.e. onset of muscle activity) which elderly had while getting up from a chair during STS movements cycle. Novak and Brouwe (2013) by use of simultaneous 3D motion capture and force plate implication distinguished the differences of stance phase during ascend and descend of staircase in healthy individual and people with stroke.

Equivalently, Teixeira-Salmela and colleagues (2001) used a synchronization of 2D kinematic and force plate to evaluate the effect of muscle pattern of combined strength (isometric, concentric and eccentric) and aerobic trainings on temporal gait parameters in individual with chronic stroke. Selected period of synchronised data in this study showed significant enhancement in gait speed after training protocols, which was associated with higher level of power owing to an increased positive work by the ankle plantar flexor and hip flexor/extensor muscles in chronic stroke survivors. Moreover, Olmer (1994) using a synchronization pattern of 2D kinematic and EMG features from gait analysis enabled to determine the volume changes, motor coordination, volume partitioning, typical patterns from Sync configurations in pulmonary function and its alterations in aged populations.

More interestingly, the use of coordinated kinematic and kinetic biomechanical variables can address individuals' adaptability to sport facilities to optimum physical performances or pattern modifications during mechanical loads in various sporting and clinical uses.

For instance, Pratt and Sigward (2018) recently using a synchronized of 3D motion capture and force plate analyzed an inertial sensor angular velocity function to identify the gait deficits during single limb loading in induvial following anterior cruciate ligament reconstruction (ACLr). The reported sagittal plane peak thigh angular velocity was the best predictor of peak knee power absorption and peak knee extensor moments during a single limb-loading task in individuals with altered knee loading following ACLr.

In another recent study, Ter and Colleagues (2015) used an integrated 3D kinematic and force platform to evaluate the pressures sites of upper extremity sites while walking – assisted gait. The integrated data which incorporated with Visual3D motion analysis upper body model elicited without changeling the usage of walking pattern, the internal force and joint moment for the wrist, elbow and shoulder could determine the pressures sites in these areas while using an instrument walker .This implication will benefit prolonged usages in large populations in rehab practice .

Furthermore, Boyer and Andriacchi (2009) used a synchronizing approach to investigate individual's joints (hip, knee, ankle) adaptions to a rockered shoe design to prevent injuries during running. The analyzed synchronous of 3D motion capture and force plate variations through inverse dynamic analysis revealed major difference in sole geometry in terms of most potential sites of injuries that accommodated to the rockered running shoe were found only at the ankle joint in sagittal plane compared to the knee and hip joint. This finding outlined that the load modification during running using a rockered shoe was required to apply in ankle joint without any major considerations to other joint dynamics.

In addition, Campbell et al. (2007) recruited a synchronized of 3D kinematic and force plate approach to guide the clinicians who apply braces to their patients for potential changes and the potential risk that brace application my cause to the unbraced limb. They found that wearing a knee brace affect reduced both hip and knee flexion joints but not ankle in braced (B) group compared to non-braced (NB) group during jogging gait. They further explained any changes in the kinematic in jogging could occur at joints proximal to the braced joint such as hip and pelvis or unbraced limbs in order to sustain the reaction force per each successive step. However, they also indicated these repetitive changes in hip joint are determinate factors to hip and low back function that could lead to the injuries in B group.

3. Conclusion

In biomechanics , synchronizations of video-based kinematic, (2D or 3D) align with digitized records of analog data such as electromyographic (EMG) signals or force platform or both allow characterizing large quantities of biomechanical configurations in variety of human movements. Mechanically speaking, the use of synchronizing techniques could aid to distinguish mechanism that is behind daily perplexing phenomenon in different modes of walking in sportic and rehabilitative sectors. It also used to conduct greater understanding of areas of muscle weakness, potential injuries to promote performances in competitive sports. Biomechanical analysis of diverse synchronized kinematic and kinetic features frequently is used to design of diverse clinical paradigms for optimum functional recovery after stroke. More intriguingly, coordinated kinematic and kinetic biomechanical configurations can address individuals' adaptability to sport facilities to optimal physical pattern modifications during mechanical loads in various sporting and clinical practices. Therefore, the synchronous of video – derived kinematic and kinetic acquisition importantly demands to be considered as common practice in sporting research and therapeutics programs.

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10

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Monitoring and Evaluation Component of Test Control System in Physical Education of Students with Chronic Health Conditions

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Abstract

Ensuring the effectiveness of physical education of students with chronic health conditions is possible only if proper test control system is available. Taking into account the importance of the conclusions that are made in accordance with its results, the questions of objective assessment and correct interpretation of monitoring results acquire a special urgency. Purpose. Theoretical modeling of the monitoring and evaluation component of test control in physical education of students with chronic health conditions. To achieve the goal such methods are used: analysis and synthesis, systematization and generalization of research results of ascertaining and forming stages of the experiment, the theoretical modeling. Results. The principal provisions of the developed model of monitoring and evaluation component of the test of students with chronic health conditions are presented. The practical implementation of the proposed assessment technology provides personal approach in assessing and objectivity of information processing. Novelty and innovation of represented monitoring and evaluation component are based on the integral assessment. At the same time, it provides maximum weighty and detailed information about the individual dynamics of parameters of students' psychophysical condition under the influence of physical education.

Keywords: testing, control, assessment, monitoring, model, result, technology.

1. Introduction

Taking into account the annual increase in the number of students with chronic health conditions which are directed to special groups for physical training classes because of their health status, the state of modern physical and recreation activities in universities is the subject of close attention (Konkabaeva, et al., 2016; Ruscitti, et al., 2017). The majority of field scientists share opinions on the ways of effective implementation of the target direction of students with chronic health conditions in physical education. Experts assert that this requires an effective system of control (Bondarevskiy, 1983). The perspective direction to increase the effectiveness of physical education is development and practical implementation of new high technologies of test control (Alfrey, et al., 2014; Koryahin, et al., 2017). Students with chronic health conditions warrant specific recognition and access to educational resources including within the field of test control in physical education defined in scientific works (Baghurst, et al., 2014; Di Tore, et al., 2016).

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2. Reviews of related literature

The leading field experts emphasize the uniqueness of students with chronic health conditions control in physical education (American College of Sports Medicine, 2010; Blagush, 1992; Fanelli et al., 2007). Today there is a considerable amount of theoretical empirical material on the control in physical education (Godik, 1988). However, aspects of the of students with chronic health conditions test control are almost out of scientists' view. Discussion of the test monitoring of students with health deviation is very limited in modern native literature.

The urgency of the study is determined by the need to find the ways to increase the effectiveness of physical education, which implies the necessity of more accurate regulation of the order and the organization of the control of this process in the educational institutions (Keating et al., 2009).

Thus the analysis of the scientific heritage on the proposed theme indicates the necessity to study, systematize, justify and research further in order to generate evidence-based technology of processing the test monitoring results of students with chronic health conditions in the process of their physical education.

3. Methods and organization of the research

General Background of Research. A theoretical modeling of monitoring and evaluation component of the test control in physical education of students with chronic health conditions. The object of the research is the control in the physical education of students with chronic health conditions.

Instrument and Procedures. To achieve the assigned tasks the following research methods were used: general scientific methods of theoretical level: analysis and synthesis, systematization and generalization of research results in the ascertaining and the formative stages of experiment, theoretical modeling (Bogdan, et al., 1982; Cohen, et al., 2007; Zatsiorskiy, 2006).

Type of the Research. This research is theoretical qualitative research. The type of this research is descriptive modeling research.

4. Results

The general hypothesis of the study is based on the assumption that the qualitative control in the physical education of students students with chronic health conditions, as a major factor in the formation of the competent management decisions, is the basis for improving the efficiency of physical education.

The final testing stage is an educational evaluation of test measurements results (Koryahin et al., 2013). Evaluation is considered to be a key influence factor in education as a whole (Alfrey et al., 2014; Baghurst, et al., 2014).

According to the estimation theory (Zhu, 1998) assessment in physical education consists of several stages. At first, one chooses a scale, which can be used to convert the test results into evaluation marks. Further, in accordance with the selected scale test results are converted into points. And finally, the points obtained are compared with the standards (Godik, 1988).

However, according to the data of empirical research (Mercier et al., 2013; Baghurst et al, 2015), current tests used in the practice of students with chronic health conditions physical education ignore the specific characteristics of these students.

In our study, the monitoring and evaluation component is a local stage of practical implementation of the test control technology. Monitoring and evaluation component performs diagnostic and evaluative function of test control. These functions require systematic analysis of physical education results. Its task is to get objective and reliable information about this process. This allows to make adjustments not only in the educational process, but also in monitoring and evaluation system.

Monitoring and evaluation component of the test control technology is presented as a interrelated complex of formulated basic regulations and organizational and methodological conditions for its effective implementation. At the heart of the development is a systematic diagnostic approach. It provides for objectives, principles and objective criteria of evaluation to eliminate subjectivity in the analysis of the of physical education results.

The developed model of technology assessment of test monitoring results in special medical groups is based on the necessity to improve the content of normative provision control (Figure 1).

It is designed as a semantic model of procedures. These procedures integrate organically organizational and technological mechanisms of information processing. In fact, it is an ordered complex of operations on the formation of its results. The latter reflect the results of physical education for the period of students stay in the educational establishment. This is the way to ensure obtaining a reliable empirical evidence for the formation of an "information base "and its further processing.

The basic provision of the theory of control results (Godik, 1988; Zatsiorskiy, 2006; Zhu, 1998) assessment have become the methodological basis of the model. In accordance with them, the assessment should be systematic, objective, reliable and differentiated. The main idea of assessment model is supported and specified by key provisions of test control concept. The exact implementation of these provisions ensures the accuracy of the assessment of the monitoring results.

The idea of the proposed model is based on the formation of mechanisms of obtaining information on the individual dynamics of the parameters of students with chronic health conditions test monitoring during their physical education. The function of the monitoring and evaluation component is processing and analysis of test control data.

Formation of the monitoring and evaluation component of test control of students with health deviation requires a compliance with a number of principles. As a general action-guiding norms it is theoretical provisions of the substantive nature of the assessment. The principles reflect the general requirements for the content, organization and methods of this process and determine its direction.

Consistent compliance and account of certain principles ensure a purposeful functioning of the monitoring and evaluation component of test control. Among them:

1) a principle of scientific content; it provides for an assessment from the standpoint of the tests and evaluation theory;

2) a principle of comprehensiveness; it anticipates that the assessment must be comprehensive;

3) a principle of adequacy; it implements person-oriented evaluation;

4) a principle of the information content; it anticipates that the evaluation must provide for a maximum of information;

5) a principle of impartiality (objectivity), this principle provides for obtaining reliable informative results of the test control.

Organizational and methodical conditions of effective functioning of the monitoring and evaluation component of test control are defined. The conditions are presented as a set of measures, the implementation of which ensures the formation of operational and technical aspects of assessment. Among them:

1) an individually differentiated approach;

2) a person-oriented approach;

3) an integrated approach to the assessment of the test parameters;

4) transformation of assessment in accordance with a level of the body functional ability providing for the correction of difficulty level.

Implementation of a person-oriented approach required science and practice reference to the activity aspects of innovative, personalized and differentiated assessment. The solution of this problem consisted in the identification of priorities in the choice of methods and means for individualization of the assessment. These are essential conditions defined by the concept of control humanization (Bondarevskiy, 1983; Zatsiorskiy, 2006).

Assessment technology of the test control results in special medical groups is designed so that to ensure objectivity of results, processing efficiency and impact effect assessment with minimal time. It allows to determine the most fully the quality of parameters under test. This will contribute to the effective functioning of the test control as a whole.

Practical implementation means of the monitoring and evaluation component of test control are didactic materials for the controlled process implementation.

The results of each student test monitoring are systematized in the form of protocol and submitted in the form of integrative index. This index determines the degree of development of the studied parameters in figures. The final quality assessment is set according to the integrative index.



Fig. 1. Flow-chart model of monitoring and evaluation component of test control system in physical education of students with chronic health conditions

Regulation of methodology issues of the monitoring and evaluation component of test control can be described as an ordered set of operations directed at generation of its results. These very results reflect the physical education results for the period of students stay in the educational establishment. The general result of its implementation is the formation of conclusions about the quality implementation of the conceptual problems on the basis of the final assessment (integrative index) of psychophysical condition of students.

5. Discussion

Educational assessment of test measurement results of students with chronic health conditions is a leader in ensuring the effectiveness of the physical education (Aiman, Konkabaeva et al., 2016; Ayers, 2004). Assessment is the basis of governance in this process and the factor, which provides performance of control functions. We fully support the scientific approaches of specialists engaged in finding the ways of optimization of physical education results (Alfrey et al., 2014; Baghurst et al., 2015; Dalen et al., 2017; Geoffrey et al., 2012; Keating et al., 2009).

Construction of assessment technology of test control results on the diagnostic basis assumes presence of objectives and control principles as well as objective criteria and quality assessment indicators of physical education to eliminate subjectivity in the analysis of results. The results of our study confirmed the existing points of view on this issue (Baghurst et al., 2014; Silverman et al., 2008; Zhu, 1998). It is believed that the evaluation system is mostly focused on the implementation of the assessment function only. Therefore it is not properly taken into account the diagnostic and corrective functions though the highest probability of comprehensive integrated assessment implementation exists in case of system diagnostic approach (Zatsiorskiy, 2006; Baghurst et al., 2004).

The model of the monitoring and evaluation component of test control of students with chronic health conditions was introduced for the first time. Its defining feature is clear systematic approach to the evaluation process and the flexibility of the model. Consequently students are able to determine the pace of their individual progress in the improvement of psychophysical condition. The principal difference of the proposed evaluation system consists in the fact that the goal is not result in subject but personal one.

6. Conclusion

The objective analysis of the test study results provides specific data for operational management of physical education process of students with chronic health conditions. Conceptual framework of test control system of students with chronic health conditions have become the preconditions for quality assessment issue solution. Basic provisions of the theory of control results assessment are the methodological basis of the model. System-diagnostic approach, didactic principles and pedagogical conditions are put into the basis of the development.

The result of the study was the creation of a model of the monitoring and evaluation component of test control of students with chronic health conditions physical education. It is presented as a system of means. The latest adequately reflect current and interim results of physical education of students with health deviation. The main characteristic of the model is the objectivity of the information processing regarding the changes in psychophysical condition of students with chronic health conditions. The systematic assessment of the final results and the formation of the final judgments as well as the efficiency of statistical and analytical information collection are also the basis of the final expert conclusions and judgments on its effectiveness and identification of factors of possible deviations from the plans.

Didactic model of the monitoring and evaluation component of test control is presented as an integrated assessment technology of results of students with chronic health conditions physical education. The main vector of innovation is implementation of forms and methods of personal approach in the assessment. It provides for the use of objective diagnostic criteria: morphofunctional state of the body of students with chronic health conditions, their age features and entry-level of psychophysiological state.

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The Efficiency of the Professionally Applied Physical Preparation of Students with Diseases of the Nervous System

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Abstract

Purpose: the effectiveness of the developed program of professionally applied physical preparation of students of special medical groups with diseases of the nervous system in technical university based on control psycho-physiological functions to experimentally establish. Material: in the investigated was attended by students of special medical groups of the National University «Lviv Polytechnic»: 40 boys and 40 girls with diseases in the functional state of the nervous system in a state of remission. Results: that the integrative assessment of psycho-physiological functions in the students of the sample under study is very low, according to the results of the ascertaining experiment it was established. That under the influence of the developed professionally applied physical preparation, a significant improvement in all the studied parameters of psycho-physiological functions in students of experimental groups was revealed it is shown. Conclusions: the application of the proposed professionally applied physical preparation program during the course of physical education achieved the much better results in solving tasks than the traditional organization and content of physical education, which are used in the control group.

Keywords: student, physical education, special medical group, professionally applied physical preparation, authoring program, psycho-physiological functions.

1. Introduction

The main task of the national high school is to prepare students for effective professional activities. The success of its decision largely determines the development of the country and its place in the world community. Ukraine has actively embraced world trends in improving the health of the population through education. Currently, the quality of higher education is identified with the quality of training of skilled professionals (Blavt, 2016). What is an actual problem of pedagogical theory and practice.

One of the leading places in the formation of readiness for work belongs to professionalapplied physical training (further PPFP) students in higher education institutions. PPFP provides realization of the potential of formation of personal and professional qualities of future specialists (Lyudovyk, 2014). So effective solution of production tasks is provided by an appropriate level of their psychophysical condition. From this angle, attention is paid to the permanent positive dynamics of students with diseases of various somatic etiologies. Accordingly, the number of students targeted at specialist medical groups (SMG) in institutions of higher education is constantly increasing (Koryahin et al., 2013).

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The problem is exacerbated by the fact that SMG students with a higher incidence of diseases than the students of the main medical groups are characterized by reduced capacity for work (Anikieiev, 2015). Thus, the training of students with a disability in health to highly productive work necessitates the search for a specific management. The above defines the importance of the PPFP as an organized didactic process for the formation of a specialist (Viktorov et al., 2018). Given the tendency to deteriorate health of carriers of intellectual potential of the country, the issue of the effectiveness of such training is relevant.

2. Reviews of related literature

The content of PPFP students, ways of improving its effectiveness are based on a broad source base. The scientific and theoretical foundations of PPFP students of higher technical educational institutions are considered (Olkhovskaya, 2017). It was emphasized on the necessity of increasing the efficiency of students' professional training in accordance with the requirements of production. Focusing on the optimization of PPFP students in the field of technical education, taking into account globalization and rapid technological development (Golovchenko et al., 2001). The problems of PPFP students of higher education institutions of technical profile (Lyudovyk, 2014) were investigated. The content of control in the process of PPFP (Koryahin, et al., 2013) is proposed. The PPFP is considered in the light of a particular specialty (Viktorov et al., 2018). The methodical provision of PPFP students in SMG (Olkhovskaya, 2017) is substantiated.

It was determined (Golovchenko et al., 2001) that "professional training" is directly dependent on the level of physical fitness and the state of psychophysiological functions. In the interpretation (Ohromy, 2005), the latter are to some extent correlated with this process. Thus, the observation of psycho-physiological functions is used in the field of employment, professional selection, in forecasting the quality of the labor process, etc. (Lyudovyk, 2014; Ilyin, 2003).

At the same time it was found out (Korobeynikov, 2002) the dependence of physical efficiency on the state of psychophysiological functions. The conditionality of their development is empirically determined from the level of motor activity of students (Adyrkhaiev, 2014). The influence of health on the development of physiological functions was confirmed (Ribot, 2017). It is proved that the character and the localization of diseases to one degree or another also correlates their state (Koryahin et al., 2018). Therefore, it is a factor that needs to be taken into account in the process of PPFP formation for students with disabilities in their health.

The theoretical analysis of scientific literature found that existing searches are concentrated mainly on problems with students of basic medical groups. PPFP students in SMG was not the subject of scientific analysis and the subject of extensive research. At the same time, we find in the literature (Ayers, 2004) the conviction that the students should be constructed on the basis of peculiarities of the psychophysical state. There is evidence (Koryahin et al., 2013) that the current PFPP program in higher education institutions is practically not adapted to the contingent of students with disabilities in health. There are no studies on correction of the students' psychophysical state in the process of their PPFP. Programs of PPFP taking into account the nature of the diseases of students, in particular violations in the state of the nervous system (further NA), not found. The literature does not solve the scientific and practical problem of increasing the efficiency of students with diseases of the National Polyclinic in the process of PPFP. At the same time, we find information (Korobeynikov, 2002) that such diseases are factors influencing the physical and psycho-physiological development of students. There is evidence that the proper development of attenuation abilities ensures the success of professional activity (Ayers, 2004). It has been established that their development, and, in addition, the development of power abilities and strength endurance correlates with the lability and force of the nervous system (Ohromy, 2005). The latter are a factor in violations of cognitive function. That has a certain impact on the success of learning and the development of cognitive activity (Koryahin et al., 2018).

However, it has been established that the existing PPFP programs do not take into account all of the above-mentioned factors. At present, there are no studies on the correction of psycho-physiological functions in the course of PPFP of students with diseases of the nervous system.

The hypothesis of the study is based on the assumption that the implementation of PPFP in the SMG, taking into account the peculiarities of students' illness, will increase its effectiveness. The question of optimal organization of classes for ensuring the proper level of psychophysical readiness of students is relevant for solving the problems of their preparation for productive activities. On the other hand, the results of the control of psycho-physiological functions are a significant factor in the correlation of pedagogical influences in the process of PPFP.

Purpose: to experimentally determine the effectiveness of the developed program of PPFP students with diseases of nervous system in the physical education of higher education institutions technical profile on the basis of control of psycho-physiological functions.

3. Methods and organization of the research

Participants: students of the National University "Lviv Polytechnic" of the first year of study were selected for research. They were directed at SMG in the state of health. Of the 40 boys and 40 girls, two control (CG) and experimental (EG) groups were formed. The study sample was formed from students with diseases in the functional state of the nervous system in remission. The requirements for the adequacy of its volume at the level p < 0.05 are met. Participants received written permission to participate in the experiment.

Procedure. The methodology for monitoring the effectiveness of the program is based on research psychophysiology of labor (Blavt, 2016). As well as the study of psycho-physiological features of specialists in the technical industry (Lyudovyk, 2014). The control of psycho-physiological functions was carried out on the basis of the assessment of mental endurance, working capacity, cognitive functions and attentional abilities. Used: "Tepping test" (Korobeynikov, 2002), "Technique Munsterberg" (Munsterberg, 1915), Benjamin B. Bourdon test, E. Krepelin test (Andreassi, 2000).

"Tepping test" (Korobeynikov, 2002) is used to evaluate the properties of the National Assembly. The test is based on measuring the time of maximum pace of movement of the brush. The test material contains a piece of paper with six squares drawn. On the signal it is necessary to put stereotyped movements of the brush fast in each square for 5 seconds, as many points as possible with a pencil. Without interrupting the work, the clock moves to the next square. The result processing involves counting the number of points in each square. The results determine the properties of nervous system: the indicator of dynamic endurance (DDP – ability to maintain the pace of work); lability of the motor apparatus (LRA – speed of switching from one type of activity to another); coefficient of mobility of the of nervous system (CRNS – motor mobility coefficient). Interpretation of the results is carried out according to test scales.

"Technique Munsterberg" (Munsterberg, 1915) is aimed at determining the selectivity of attention. The material of the technique consists of a letter test letter with words. It is necessary to find and emphasize these words. Estimated number of selected words and the number of errors (missed and wrongly selected words). Processing results: TM indicator is calculated from time estimate (T) corrected for errors (C – each missed word is estimated at 1 point). The calculation formula has the form: A = T - C. Assessment of the test according to the scale of the table.

Bourdon Correctional Sample (Benjamin B. Burdon) (Andreassi, 2000) is used to evaluate the parameters of attention. Sample material contains a standard test form. The letterhead is randomly printed in 2000 letters. The task of the subject is to find the letters "d" and "p" and strike them for 10 minutes with a signaling interval per minute. The results of the test are estimated by the number of missed unsigned characters, the time of execution and the number of revised characters. This is expressed by the number of processed lines and the number of errors allowed for each minute interval of testing.

Processing results: the concentration of attention (C) is calculated by the formula: $K = C_2/P$, where C – the number of revised tables in the table, P – the number of errors. The mistake is to skip letters that need to be strikethrough, as well as incorrect strikethrough. Stability of attention (K_u) is estimated for every 60 seconds by the formula: $K_u = S/t$, where S is the number of letters in the revised part of the corrective table, t is the execution time. The efficiency indicator (Pr) is calculated by the formula: $C = (S_0/S) * 100 \%$, where So is the number of erroneously processed lines, S is the total number of rows in the processed part of the table. The obtained results are compared with normative indicators.

E. Krepelin's test (Andreassi, 2000) was used to evaluate mental performance. The test material contains a standard test form. On the blank, one pairs of single digits are printed. Task of the subject – determine the result of adding a pair of digits in each line to the signal. Go to the next line every 20 seconds. The Mental Capacity Ratio (RPC) is calculated as the ratio of the sum of correctly executed additions of the last four rows (S2) to the sum of correctly executed additions of

the first four rows (S1): K = S2/S1. If the ratio is closer to 1, then this means that fatigue is practically non-existent.

Testing is implemented at the beginning of the classes and at the end of the course. The criteria for the effectiveness of the study were the dynamics of the investigated parameters. In the process of implementing the experiment, there are no laboratory artificial conditions for conducting it.

Statistical analysis. To characterize the results, indicators of descriptive and inductive statistics are used (Vincent, 2005). The difference between the average group was considered to be valid at values p < 0.05 for a given number of degrees of freedom.

4. Results

In order to ensure the objectivity of the expert conclusions regarding the conducted research, a statistical analysis of the characteristics obtained at the beginning of the experiment was carried out (Table 1). It was established that at the beginning of the study, the significance of the indices in the students of the experimental groups among themselves was not significantly different. The homogeneity of the sample ensured the representativeness of the data obtained, the objectivity of the conclusions and the veracity of the interpretation of the results. The test results were processed in accordance with the requirements of the techniques used.

According to the results of the stage of experiment start, others the tacit assessment of psycho-physiological functions in students with nervous system disease was at a very low level. In order to establish the dynamics of the working capacity of the nervous system, as an indicator of the functional state of the body of students, "Tepping test" was used. The decrease in the number of points from square to square during the test, which was observed in the vast majority of students, has shown a low level of functional stability of the motor sphere and nervous system. There was a decrease in qualitative controlled indicators in terms of the effect of mental stress during the tasks. In the results of dynamic endurance and lability of the motor vehicle, there were no significant differences. Their digital values are evidenced by the low level of this indicator among students in the sample.

Turner d'autor d			CG (n=20)								
parameter	sa S	Х	S	As	Me	V	Х	S	As	Me	V
DDP,	m	6,06	0,44	0,23	6,00	36,8	6,26	0,37	0,36	6,11	43,4
RU	f	7,01	0,91	0,39	6,99	37,5	7,14	0,29	0,58	6,44	39,1
LRA,	m	2,38	0,61	0,83	2,22	37,4	2,47	0,42	0,70	2,13	33,5
RU	f	2,26	0,68	0,37	2,11	36,2	2,30	0,31	0,46	2,13	26,7
CRNS %	m	0,53	0,10	0,55	0,45	34,7	0,52	0,08	0,53	0,43	33.4
01000,70	f	0,51	0,09	0,32	0,34	34,5	0,50	0,05	0,54	0,32	30,1
"TT"	m	6,14	0,84	0,52	6,09	39,0	6,05	0,48	0,34	6,00	28,4
evaluation, points	f	5,01	0,66	0,68	4,98	40.4	4,99	0,65	0,22	4,78	44,1
A points	m	5,99	0,52	0,54	5,88	38,9	5,91	0,42	0,62	5,66	32,1
A, points	f	6,51	0,61	0,30	6,43	31,7	6,97	0,73	0,52	6,66	28,7
Τ 0/	m	70,23	2,11	0,47	69,3	35,1	71,57	3,15	0,20	69,9	33
1, 70	f	74,15	3,09	0,60	73,2	29,7	72,73	4,11	0,79	73,1	37,6
T aiama	m	1301	102,3	0,45	1300	43,4	1299	111,5	0,38	1270	45,5
I, signs	f	1403	155,7	0,56	1401	39,1	1431	123,1	0,41	1421	28,6
С %	m	38,48	5,2	0,35	38,32	33,5	37,62	6,1	0,51	36,32	25,4
0,70	f	41,63	4,6	0,52	40,92	26,7	40,88	5,8	0,50	40,11	35,7
Pr %	m	43,51	4,7	0,38	42,43	33.4	42,79	5,1	0,54	42,04	42,2
11,70	f	41,22	3,8	0,67	40,11	30,1	42,12	4,8	0,14	40,11	34,5

Table 1. Parameters of the psycho-physiological state of students at the beginning of the experiment (p > 0.05)

	m	51,45	5,2	0,80	50,33	28,4	53,6	6,1	0,44	52,34	43,5
$\mathbf{K}_{\mathrm{u}}, \mathrm{KU}$	f	60,68	4,6	0,72	59,4	23,9	59,5	5,8	0,34	59,2	26.7
4 ~	b	240,1	37,3	0,88	237,9	29,8	238,5	22,3	0,36	235,9	36.4
t, s	g	223,2	25,2	0,02	221,4	37,2	225,4	18,3	0,58	224,4	37,5
MDD DI	m	0,59	0,09	0,39	0,58	31,2	0,60	0,07	0,70	0,57	37,4
MITK, KU	f	0,53	0,11	0,83	0,51	33,4	0,55	0,09	0,46	0,54	36,2

Legend: DDP – ability to maintain the pace of work; LRA – speed of switching from one type of activity to another, CRNS – motor mobility coefficient; "TT" – "Tepping-test"; A – switching attention; T – accuracy of attention; I – mental indicator of productivity; C – concentration of attention; K_u – stability of attention; Pr – performance efficiency; t – attention selectivity; MPR – mental capacity ratio; RU – relative unit; EG – experimental groups, CG – control groups, m – male students; f – female students

At the beginning of the study, the parameters of attention of students in experimental groups are below the mean and average values. There are trends in reducing the mental capacity for work.

At the end of the experiment, we observe a significant positive dynamics of the studied indicators (Table 2).

According to a qualitative criterion, the results obtained at the beginning of the experimental study of the motor mobility coefficient (CRNS), which is an indicator of its dynamic working capacity, 4.7 % of students had the first level, all the others –the second. Persons with a high grade among students of research groups have not been identified. At the end of the experiment, 78.2 % of the people who had registered the positive dynamics of the mobility coefficient of the nervous system were enrolled in the EG. In digital terms, it has reached the middle level.

Investigation of the parameters of attention has shown the following. The slowness of switching attention (A) was observed in the students of the experimental groups at the beginning of the classes as a factor in reducing the quality of work. Before the beginning of the experiment, the level of switching attention among the students of the EG was within the low range. At the end of classes we see a significant increase in switching attention to the average functional level.

By the end of the experiment, the qualitative values of the accuracy of attention (T) in the students of EG achieve a positive dynamics in the range up to 30 % (p < 0.05). The quantitative values of the productivity index (E) have improved significantly in terms of the results obtained in the first year (p < 0.001). This testifies to increased stability of the level of active attention in the students of EG.

			EG	(n=20)			CG	(n=20)	
Investigat paramete	ed rs	Х	S	+ (%)	р	Х	S	+ (%)	р
DDP,	m	4,76	0,61	21,4	<0,001	6,22	0,44	0,6	>0,05
RU	f	5,72	0,77	18,4	<0,05	7,12	0,38	0,2	>0,05
LRA,	m	3,09	0,72	29,8	<0,01	2,45	0,48	0	>0,05
RU	f	2,90	0,78	28,3	<0,01	2,36	0,61	0,21	>0,05
CDNS %	m	0,66	0,09	24,5	<0,01	0,52	0,04	0	>0,05
CKN5, 70	f	0,63	0,11	23,5	<0,01	0,51	0,03	2,0	>0,05
"TT"	m	7,36	0,63	19,8	<0,05	6,11	0,71	1,2	>0,05
evaluation, points	f	6,01	0,81	19,6	<0,05	5,05	0,88	1,1	>0,05
	m	8,42	1,01	33,5	<0,001	5,76	0,63	0	>0,05
A, points	f	9,08	1,14	36,1	<0,001	7,08	0,54	0,2	>0,05

Table 2. Parameters of the psycho-physiological state of students at the after of the experiment

European Journal of Physical Education and Sport, 2019, 7(1)

T 0/	m	85,1	2,88	20,8	<0,05	73,63	2,28	2,7	>0,05
1,%	f	90,5	2,16	21,6	<0,05	75,31	3,01	4,1	>0,05
Laigna	m	1770	88,4	36,2	<0,001	1315	99,9	1,2	>0,05
i, signs	f	1865	92,3	32,1	<0,01	1501	103,8	4,8	<0,05
C %	m	48,7	4,4	25,6	<0,01	38,63	5,1	1,7	>0,05
C, 70	f	54,1	5,3	33,3	<0,001	42,46	4,9	2,4	<0,05
Pr, %	m	56,2	4,2	29,2	<0,05	43,3 0	3,2	1,4	>0,05
	f	55,2	3,3	33,1	<0,05	42,32	4,5	0,04	>0,05
V DII	m	68,7	6,4	32,6	<0,05	55,8	5,1	3,7	>0,05
Ku, KU	f	76,1	7,1	26,3	<0,05	61,5	4,9	3,1	>0,05
	m	156,6	22,1	30,1	<0,0	213,4	15,4	9,1	<0,05
t, s	f	133,4	18,7	40,2	<0,001	200, 8	7,2	11,1	<0,05
MPR, RU	m	0,75	0,08	27,1	<0,05	0,65	0,03	8,2	<0,05
	f	0,64	0,04	26,9	<0,05	0,58	0,06	4,7	>0,05

At the beginning of the study, 100 % of the students of the study sample had a low concentration of attention (C), which was marked by rigor. At the end of the study, we see an increase in this parameter to a good level in the students of the EG.

The integrative index of attenuation abilities according to the results of the trial during the experiment increased in the students of the EG by an average of 33.3 % (p < 0.05). Numerical values of concentration, stability, switching and selectivity of attention reached average and good level. In general, this is a major factor in ensuring a high level of mental performance and working efficiency.

According to the provisions of system psychophysiology, the level of mental performance is ensured by the development of cognitive functions and attentional abilities (Korobeynikov, 2002). The state of the mental capacity ratio for students of EG after the completion of classes is characterized by positive dynamics. As a result, in numerical values, it approaches one.

The research of psycho-physiological functions has established that the change of experimental parameters in the students of CG in the course of classes is characterized by the absence of a marked positive tendency. The status of certain parameters has improved, but at the end of their numerical values do not significantly differ (p > 0.05) compared with the beginning of the study.

5. Discussion

In conducting empirical exploration, we were guided by the fact that the training of specialists in higher education institutions is a multidisciplinary specially organized process (Ayers, 2004). An important place in its course is occupied by PPFP. It is considered as a means of general, special, physical and psycho-physiological training of students for professional activity (Koryahin, et al., 2013).

The proposed PPFP for students with illnesses in the state of emergency in higher education institutions technical profile. Its distinction from the current one is organizational and methodological provision. The peculiarities of the introduced PFPP for students with illnesses of the nervous system are based on the specifics of their psychophysical condition. The latter is due to the complexity of pathological changes in the nervous system. The problem is exacerbated by the fact that it is in the departments of the nervous system that the regulation of all manifestations of the organism is centralized (Ilyin, 2003). On the other hand, the PPFP should ensure the formation and improvement of qualities important for technical specialists (Lyudovyk, 2014).

The obtained results showed that the implementation of the envisaged content of the PPFP in the EG provides an effective solution to the tasks of the experimental program. The effectiveness of its influence on the state of psycho-physiological functions and mental efficiency is proved. Thus, the hypothesis of the study is confirmed.

As in the works of other authors (Koryahin, et al., 2013; Lyudovyk, 2014), it was found that modern requirements for training specialists predetermine the necessity of substantially updating

the methods of PPFP. The scientific research carried out was aimed at supplementing the scientific understanding of the necessity of introducing the principles of individualization in this process. The unity of the position of researchers is the need to take into account the individual characteristics of the organism, adjusting the capacity for work. According to the reports (Korobeynikov, 2002), they are in a state of health, levels of physical development and physical fitness, and the effectiveness of psychophysiological functions.

The conducted scientific research is substantiated from the standpoint of the necessity of controlling psychophysiological functions within the functional study of SMG students in order to control the process of their PPFP. In particular, information support of the medical and pedagogical aspects of decision making in relation to its correction of this process. In the course of the study, we were convinced that the management of PPFP is provided by timely monitoring measures in the physical education of the SMG. This position supplements the existing literature data (Anikieiev, 2015; Viktorov, et al., 2018).

Guided by reports on the state of psychophysiological functions, as a potential for ensuring the professional preparedness of students (Olkhovskaya, 2017), it is interesting to notice the role of nervous system violations in this process (Ayers, 2004). Our studies are consistent with the information (Koryahin, et al., 2018) that the level of development of psychophysiological functions most adequately reproduces the functional state of the organism of students, its ability to implement the author's program. It is determined that deviations in the state of emergency affect the efficiency of mental activity to a certain extent (Korobeynikov, 2002). This is due to its leading purpose in the body and the management function in relation to other systems (Munsterberg, 1915). Diseases of the nervous system and the properties of the nervous processes (strength, mobility, balance) are a factor of deterioration of attention concentration, growth of nervous tension, a significant increase in the time of solving problems, rapid fatigue, etc. A correlation of the functional state of the state of emergency and the state of psychophysiological functions was established (Ilyin, 2003). In particular, the intellectual activity depends on the conditions of blood supply to the brain. It is proved (Andreassi, 2000) that even minor violations of blood circulation in the brain are a prerequisite for negative reactions from the intellectual capacity. In mental work, functional shifts occur primarily in the nervous system (Korobeynikov, 2002). The efficiency of the nervous system is the physiological basis of labor productivity (Andreassi, 2000).

It the beginning of the study, the parameters of attention of students in experimental groups are the result of pathological inertia of the processes of excitation and inhibition in the nervous system. Accordingly, the regulation of psycho-physiological functions creates the basis for improving the functional state of the nervous system (Ohromy, 2005). And, consequently, it is a factor in the effectiveness of the PPFP. That, accordingly, and the available information (Olkhovskaya, 2017; Viktorov, et al., 2018).

It is proved that attention, as a cognitive function and process in the state of emergency, depends on the individual physiological characteristics of the nervous system and the general state of the organism (Ribot, 2017). In particular, it is believed that the factors of weakness of attention are the mediocrity of the nervous processes. Attention is being considered (Ilyin, 2003) as a function that can be raised and improved as a result of targeted influence. In terms of the physiology of this process (Munsterberg, 1915), it is provided by inhibition of optimal excitation in some areas of the cerebral cortex of the cerebrum and its occurrence in others. The state of the parameters of attention after classes in the students of EG, probably, is a consequence of improving the state of emergency.

Indicator of accuracy of attention (T) depends on the functional state of emergency, the degree of stability and fatigue of attention. As a result, it determines the quality of the work (Andreassi, 2000). Probably, its improvement is due to the activation of the reticular system under the influence of occupations.

Indicator of productivity (I) characterizes the speed of processes of perception and thinking and depends on the mobility of nerve processes (Korobeynikov, 2002). The achievement of the limits of optimal excitation in the state of emergency by the influence of occupations has created favorable conditions for increasing the productivity of attention from the students of the EG.

The concentration of attention (C), as an important condition for the implementation of complex practical actions, is ensured by the mobility of nerve processes (Ribot, 2017). Its low level at the beginning of the study in the students of the sample is due to the presence of functional

deviations in the state of emergency (in particular, the presence of neurotic conditions, etc.). The influence of individual-typological peculiarities of students of research groups is not excluded. The results of testing concentration of attention from the students of the EG confirm data (Overton, et al., 2016; Koryahin, et al., 2018), regarding the possibility of its development. This became possible due to an increase in the general level of activation of the brain under the influence of occupations.

Improvement of the stability of attention (Ku) in EG students is a factor in improving the state of emergency, namely, the processes of excitation and inhibition in the cerebral cortex (Ribot, 2017). In addition, the probability of maintaining the necessary intensity of attention for a long time was also influenced by the fitness in the process of implementing the PPFP.

Growth of the integrative index of attentional abilities in the students of EG was a factor in ensuring a high level of mental performance and work efficiency. According to the provisions of system psychophysiology, the state of mental functioning is ensured by the development of cognitive functions and attention abilities (Andreassi, 2000). The main mechanism of its reduction at the beginning of classes is defined functional changes in the state of the central nervous system and the resulting destructive states of the body.

Understanding of psycho-physiological functions as a dynamic system, their consideration from the standpoint of physical development allows us to analyze not only the result but also the process of their correction. The latter is consistent with the reports (Ilyin, 2003) that the level of mental performance as its maximum psycho-physiological potential positively correlates with the state of health. The results of empirical intelligence are confirmed by data (Ohromy, 2005; Koryahin, et al., 2018) concerning the relationship between the potential of mental activity and the physiological state of the organism. Find information (Andreassi, 2000) on the psychophysiological support of optimal mental working capacity, which is essentially due to the general state of the organism. Our results are coordinated with regard to the "coherence of mental activity". This is reflected in the coordinated functioning of psycho-physiological functions in the relationship, which is ensured in their addition (Korobeynikov, 2002; Ribot, 2017).

The results of the study are grounds to support the position (Ohromy, 2005; Koryahin et al., 2018) regarding the possibility of improving mental performance by eliminating violations of the functional state of the organism or normalization (correction) of the state of emergency. The reduced level of mental performance among students based on the results of the qualifying phase is due to violations in the state of emergency. It is not excluded and the influence of mental fatigue, as a holistic process, which covers all levels of the motor apparatus with a limiting cortical link. This also turns out to be reduced in efficiency (Olkhovskaya, 2017; Overton et al., 2016). This condition is conditioned by the effect of a significant training load at the beginning of education in higher education institutions.

In conclusion, the belief that the level of performance is formed against the background of a particular functional state of the organism (Adyrkhaiev, 2014; Andreassi, 2000). The obtained results, apparently due to pathological inertia of the nervous processes. That, it is quite probable, is a consequence of functional disorders of the experimental groups that are localized in the nervous system. This complements the doctrine (Ilyin, 2003; Overton et al., 2016) regarding this issue.

At the same time, we agree on the results obtained regarding the possibility of restoring mental performance of students under the influence of correctional and pedagogical measures (Ohromy, 2005; Anikieiev, 2015; Koryahin et al., 2018).

It is proved (Korobeynikov, 2002) that understatement of the level or disturbance of the development of properties of attention leads to a decrease in mental activity and disability. In the same line of doctrine (Ilyin, 2003; Ribot, 2017) in relation to the purposeful development of attentional abilities. The latter are considered as a factor in ensuring the success of professional activity and the efficiency of mental performance. Improvement of mental working capacity by means of physical education is substantiated (Overton et al., 2016) in terms of physiological mechanisms for its provision. It is quite logical that the obtained data serve as confirmation of the conclusions (Olkhovskaya, 2017; Ohromy, 2005) concerning the influence of physical activity on the possibility of ensuring the efficiency of labor.

Summarizing the results of the intelligence, the own achievements (Blavt, 2016; Koryahin et al., 2018) were complemented in the framework of the implementation of the experimental program of physical education of SMG students. The expected effect of the experiment conducted is

the efficacy of the introduced PPFP. Thus, the scientific data (Adyrkhaiev, 2014; Anikieiev, 2015; Overton et al., 2016) concerning the influence of motor activity on the functional state of the central nervous system was confirmed. An indication of this is the positive dynamics of the studied parameters. Conducting a molding experiment confirmed (Blavt, 2016; Ohromy, 2005; Viktorov et al., 2018) the expediency of differentiation of PPFP in SMG, taking into account the specificity of disorders in the state of health of students. This made a contribution to solving the problem of professionally oriented physical training of SMG students, enriching the theory and method of physical education. At the same time, the data obtained contradict studies (Ayers, 2004), which indirectly support the inalienability of differentiating the educational process in the SMG on the basis of the nature of the diseases.

The scientific data (Adyrkhaiev, 2014; Blavt, 2016; Koryahin et al., 2018) on the low effectiveness of the current system of physical education in SMG at higher educational establishments has been confirmed. The change in the experimental parameters of the students of the KH indicates a weakening of the energy and regulatory processes in the central nervous system, which objectively manifests itself in the state of parameters of psycho-physiological functions.

6. Conclusion

The formation of high-level professionals with a high level of efficiency is an urgent problem of pedagogical theory and practice. PPFP is organically integrated into the physical education of students with a comprehensive pedagogical impact on the personality of a future specialist in the process of developing his professional training.

The basis of the construction of individual trajectories PPFP during the pedagogical activity was the establishment on the one hand deviations in the state of emergency, on the other – the specifics of the specialists of the technical industry. The effectiveness of work in such a field is that it has protection against the working capacity and functional state of the organism.

The PPFP program has been developed and proposed, which will ensure better improvement of the number of indicators of the traditional organization and strengthen this process in higher educational institutions. The management team completed the development of programs for the students of SMG with nervous system in the educational process, which ensured the effectiveness of equal values of the studied parameters of the students of experimental groups in comparison with the control group. Attachment of control over existing changes in stationary parameters. Summarizing the results of tests of psycho-physiological functions ensure positive changes in their parameters in the students of the EG in the range up to 30 %. At the same time, these differences have a significant significance with students of CG (p < 0.01). In the latter, the indicators of psycho-physiological functions improve only individual and lower rates, from the rest – remains at the level reached. Development of psycho-physiological functions in the process of PPFP, as a systematic introduction of the components of psychophysical readiness of students to perform their professional duties, the purchase of useful programs. The statistical significance established in the parameters of the studied parameters of the students of the experimental groups of the final experiments confirmed the effectiveness of the proposed PPFP.

Thus, the analysis of data obtained during the pedagogical experiment is subject to the practice of forming the professional psycho-physiological functions of future workers in the technical field. The conducted study allowed to provide higher education, which allows effective formation of professional readiness of students of educational institutions. Thus, it is provided with effective management of the process of recruiting psychophysical readiness of students from health care students to professional activities.

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An Exploratory Study of Collegiate Track and Field Athletes' Participation Motivations and Health Related Behaviors

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Abstract

Using 'self-determination-theory' as a theoretical framework, this study examined: features of the collegiate track and field athletes' (CT&FAs') participation-motivations; their current healthrelated behaviors; and their participation-motivations associate to the dependent variables. Participants were 283 CT&FAs (159 males, 124 females). Data correction was employed Adapt Collegiate Track and Field Athletes' Participation Motivations and Healthy Related Behaviors Questionnaire (ACTFAPMHRBQ); containing 54 items (eight invested general information, 19 examined motivation-factors (MFs) and 27 examined health-related behaviors). Results showed: the top four MFs are: 'to improve-reputation', 'high technical-content and unique-value'; 'for professional'; and 'for fun & not boredom'. The MANOVA revealed: 'Disciplines' and 'Original Motivations' did not reach significant different but 'Gender', 'Supports', 'Years in college' and 'Athlete-Grade' did. The current 'health-related behaviors' status of these participants was identified. Additionally, when using a four points scale of "Excellent, Very-good, Good, and Notgood", their overall status was on the position between excellent and very-good.

Keywords: Sport, practices, competitions, coaching, management.

1. Introduction

The sport of track and field (T&F) is defined as the foundation of all types of sports. National Collegiate Athletic Association (NCAA) in the US is "a member-led organization dedicated to the well-being and lifelong success of college athletes" (NCAA, 2018: 1). Members in this organization included 1,117 colleges and universities, 100 conference and 40 affiliated sports organizations. There are about 52,500 participants that makeup about 19,500 teams to compete each year in the NCAA's 90 championships in 24 sports across three divisions (NCAA, 2018). To make this largest sports organization become a successful organization, thousands and thousands of professionals from colleges/university presidents, athletics directors, coaches, academic advisors, athletics representatives, to relative officers, health and safety personals have to contribute their best and the most careful service. A general perception for the highest mission of NCAA is to represent the USA attending the International Universiade organized by the International University Sports Federation (IUSF, 2018). According to the IUSF (2018), the USA has won 1,300 medals in 25 appearances at the Summer Universiade and is in the first place on the all-time Summer Universiade medal table (IUSF, 2018).

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In contrast, according to Federation of University Sport of China (FUSC, 2018), the only national organization for university sports in the People's Republic of China (PRC), although their collegiate sports were started later (since 1979) and it is not as advanced and well developed as the collegiate sports in the USA. The collegiate athletics in the PRC, however, have made incredible progress in its 19 appearances at the Summer Universiade; the Chinese collegiate athletes have won 963 medals; ranked No. 2 and next to the USA (FUSC, 2018).

The construction of high-level collegiate athletic teams in the PRC's university system began in the 1980s. Its development process can be roughly divided into three stages: the first phase called the pilot phase (1987–1995); the main task is to encourage, guide and promote the development of extracurricular sports training in universities (Liu, 2018). For the first time, 51 pilot universities across the country that recruit high-level collegiate athletes were established. The second stage called the diversified development stage (1996–2005); the main task was striving to improve the competitive level of collegiate athletes and prepare for the World University Games (Liu, 2018). During this period, the universities that built high-level collegiate athletic teams were divided into two levels: one was the national pilot schools approved by the former State Education Commission; the other was the pilot schools set up by the provincial education administrative departments (Liu, 2018; Ma, 2018). The Ministry of Education established a total of 161 collegiate athletic teams. By 2001, the scales of the two-level pilot construction of high-level collegiate athletic teams were eventually adjusted to about 120 teams (Liu, 2018; Ma, 2018). The third stage called the standardization development stage (2006 - present); the main task was to continuously improve the collegiate' sports level, undertake the team and the task of the World University Games, establish a multi-channel training method for excellent athletes and strengthen the comprehensive level of high-level collegiate' sports teams (Liu, 2018; Xu et al., 2009). The scale of high-level collegiate' sports teams once again been expanded, which has led to problems such as reducing quality enrollment, re-declaration, and low quality of running teams, etc. (Liu, 2018; Ma, 2018). After the adjustment in December 2017, the total number of colleges and universities that have qualified for high-level collegiate' sports teams was 279 or 20.1 % of the total universities number, including 144 universities with qualifications for track and field events (Liu, 2018; Ma, 2018; Xu et al., 2009).

Despite people have perceived many substantial benefits, however, collegiate sports have their problems as well. Concerns have been voiced regarding the highly competitive nature of collegiate sports and it is often argued that young athletes become injured or burnout as a result of excessive stress and pressure. Still, others are thought to learn inappropriate behaviors such as aggression or poor sportsmanship from their involvement (Malina, Cumming, 2003; Jeffery, Camiré, 2016).

On the other hand, Geidne, Quennerstedt, and Eriksson (2013), Jeffery and Camiré (2016) based on their research findings indicated that: over the years, youth and collegiate sports research has failed to address the influential role of socialization agents in shaping collegiate athletes' motivation processes in sports. They recommended that collegiate sport researchers should integrate socialization influences, identifies the influence on participates' socialization patterns upon the athletes' self-perception characteristics, orientations toward achievement (both in athletics and academic success), and the patterns of motivated behavior (Geidne et al., 2013; Jeffery, Camiré, 2016).

With respect to what factors motivate the collegiate to involve sports and physical activities, Kilpatrick, Hebert, and Bartholomew (2010) indicated that although active lifestyles have many obvious benefits, lack of physical activity is still a major health problem in the collegiate population. A key point for solving this issue is to develop an understanding of participation motivation in physical activity (Jeffery, Camiré, 2016). Based on those assumptions, Kilpatrick et al. (2010) conducted a study of "College Students' Motivation for Physical Activity: Differentiating Men's and Women's Motives for Sports Participation and Exercise". Their findings suggested that: 1) for the sports engagement, they are most likely motivated by the intrinsic factors, such as enjoyment and challenge; and 2) for the physical exercise or activities, they tend to motivate by more extrinsic factors, such as appearance, weight control and reduce life stress.

Furthermore, issues and problems facing on the collegiate athletics have been found, such as: teams' leaders (e.g., coaches and faculty athletics representatives); policymakers (e. g., college presidents or program directors) lack of first hand information on what factors that really

motivated the collegiate athletes keep involved the sport they like; and lack of the relative scientific knowledge that explain why the collegiate athletes can or cannot continually participated in the sports he/she chooses (Zeng, 2019). However, little study has been conducted to cover the collegiate athletes' participation motivations and their health-related behaviors, especially in the sport of track and field. Hence conducting a study to address the above issues appear to be urgent necessary and important. Therefore, the purposes of the present study were to: (1) examine the motivation factors between their gender (male or female), disciplines (natural science or social science), and financing support (by-parents or by-school) of the collegiate track and filed athletes; (2) examine differences exist or not on the motivation factors among the collegiate track and filed athletes' year(s) in college/university (1 year, 2 years, 3 and more years), athletics-grades (grade 1, grade 2, grade 3), and original motivations (for-professional athlete, for non-professional athlete, for extra credits in enrolment). (3) To investigate the current status of the collegiate track and filed athletes' health-related behaviors. Additionally, based on the findings of this study providing strategies for the professionals in the collegiate athletics to transfer their athletics motivations to their academic efforts and accomplish higher success both in athletics and academic performance.

2. Theoretical Framework

The theoretical framework that guided this study is the 'self-determination theory' (SDT et al., 2000). The SDT is comprised of intrinsic motivation (IM) and extrinsic motivation (EM) theories. Researchers in the field of participation motivations indicated that all people possess multiple motivations, both intrinsic and extrinsic, that are simultaneously in play and must together be assumed to determine the overall quality of motivation (Ryan, Deci, 2000; Stellion, Sinclair, 2013). Researchers further indicated that individuals actually be motivated by three psychological needs: competence, relatedness, and autonomy (Deci, Ryan, 2002; Stellion, Sinclair, 2013). The competence needs in the SDT model is called effectiveness motivation; the relatedness need refers to people's needs to belong and to feel accepted by others; however, the autonomy needs refer to people's need to feel self-determined that is the source of persons' own action (Ryan, Deci, 2000; Stellion, Sinclair, 2013). The organismic needs energize intrinsic and extrinsic motivations. Researchers, however, indicated that the concept of need is too general and vague to illustrate the participation in particular behaviors and it is hard to guide empirical research (Kaplan, 2010; Pintrich, Schunk, 2002). Therefore, a few models describing how different motivations triggered by need manifest in intrinsic and extrinsic motivation in specific aspects or activities were developed (Deci, Ryan, 2002; Ryan, Connell, 1989; Kaplan, 2010; Pintrich, Schunk, 2002; Stellion, Sinclair, 2013).

Breese (1998) illustrated that athletes' intrinsic motivation should be defined as participating in a sport for enjoyment, and extrinsic motivation as participating in a sport to gain rewards. Breese (1998) further explained that when athletes begin to engage in a particular sport, they are motivated not only by intrinsic motivations but also by extrinsic motivations. Some particular sports, however, may be more dependent on intrinsic motivations than EM extrinsic motivations (Breese, 1998). The reasons are different types of sports need different types of motivations (Breese, 1998; Deci, Ryan, 2002; Stellion, Sinclair, 2013).

More specifically, other researchers illustrated that athletes' intrinsic motivation usually predicts athletes' attendance and adherence to a particular sport (Chen et al., 2014; Smith et al., 2006). In the present study, CT&FAs who are intrinsically motivated would be those who go to practice their techniques and fitness regularly for fun and for self-satisfaction; whereas those CT&FAs who are extrinsically motivated would be those who go to practice to become a better track and field athletes for winning a medal in competition (Kaplan, 2010; Stellion, Sinclair, 2013). It is interesting to know that intrinsic and extrinsic motivations have different effects on collegiate athletes (Stellion, Sinclair, 2013).

In this study, we are trying to find evidence to support those previous research findings. Additionally, we also wanted to explore how the professionals (e.g., coaches, instructors, and program managers) can better apply the SDT to their coaching, teaching, and administration; from there they may get new ideas to improve the athletics program.

Measures/Instrumentation

The Adapt Collegiate Track and Field Athlete's Participation Motivations and Healthy Related Behaviors Questionnaire (ACTFAPMHRBQ, Zeng, 2019) were employed for data

collection. The ACTFAPMHRBQ contained three parts: Part I asked 'General Information', contained eight questions that covered participant's general information. Such as: How long have you officially engage in T&F? Financially, who supported you engaged in T&F practices and competitions? Part II asked, "What factors/reasons motivated you took part in T&F practices and competitions continually"? With 19 motivation factors (MFs) providing, the participant can respond to each MF in a 5-points Likert type scale (5-points represents "Strongly agree ", 4-points represents "Agree", 3-points represents "Somewhat-agree", 2-points represents "Little-agree", and 1-point represents "Disagree"). Part II of the questionnaire contains 10 IM factors (items 1, 2, 4, 7, 8, 10, 13, 14, 15, and 17) and nine EM factors (items 3, 5, 6, 9, 11, 12, 16, 18, and 19). In other words, it included all three basic psychological needs (competence, relatedness, and autonomy) described by Ryan and Deci (2000). Part III examines the health-related behaviors, containing 27 questions that allow the participant to respond in his/her best choice within A, B, C, and D options.

Reliability and Validity of the Instrument. According to Child (1990), in order to explore the possible underlying factor of the structure for a set of measured variables without imposing any preconceived structure on the outcome, the exploratory factor analysis (EFA) is the best solution (Child, 1990); therefore, the EFA was performed for the CTFAPMHRBQ (Zeng, 2019). Results revealed: the analysis extracted six factors with perfect correspondence to the 19 items with eigenvalues for the reasons or factors ranging from 2.75 to 8.67 and structure coefficients from .78 to .92 and the majority of the fitted residuals reached the pre-set-up significant difference (P < .05) level (Child, 1990).

Furthermore, the validation process was through a pilot study, reviewing the content or items. These processes confirmed the following concerns: a) the readability and writing skills of the collegiate athletes (with the consideration of translate from English version to Chinese version); b) whether or not those participants can truly understand and respond to the questions in the questionnaire correctly; c) it may result in re-wording on some questions or statements to improve the understanding for those collegiate athletes; d) it may result in cutting or adding numbers of the questions or statements in the questionnaire, and e) whether or not the questions or statements have covered all the possible motivation factors or reasons for the collegiate athletes engaging in T&F practices and competitions. As a result, the CTFAPMHRBQ (Zeng, 2019) contained three parts (as described previously). All questions and options in CTFAPMHRBQ can be found in Tables 1, 2, 4 and 6.

Methods

The sports of track and field (T&F) are the earliest and most representative competitive collegiate sports projects in Chinese universities (13). The main features of high-level athletes are there were significant differences among their sports technical level and cultural foundation (Liu, 2018). Since the establishment of high-level T&F teams in colleges/universities, it has experienced more than 30 years of trials and developments; and has cultivated many high-level, high-quality athletes, which greatly promoted the popularization and development of university sports activities (Liu, 2018; Ma, 2018).

Participants

The T&F athletes in this study were from 18 universities with advanced admission qualifications (these universities enrolled students from all regions and provinces in China), and general high (grades 10-12) schools, youth sport schools (grades 8-12), provincial team athletes (current or retired) three sources. Their Athletic-Grade were: Elite/Master = 18 / 6.36 %; Grade-one = 91/ 32.15 %; Grade-two= 135 / 47.70 %; Grades-three = 39/ 13.78 %. Male athletes = 159 / 56.79%; and female athletes = 121 / 43.21 % (for the 'Athletic-Grade' refer to "Chinese Athlete Technical Grade Standard, 2018)".

The procedures of recruiting the participant were as follows: 1) obtained an approval for conducting this survey study from the Institutional Review Board (IRB) of the college/university; 2) followed the proposal guidelines for conducting survey study within the colleges/universities of the Federation of University Sport of China (Chinese Athlete Technical Grade Standard, 2018); 3) submitted all the necessary documentation to the colleges / universities administrator(s); 4) contact the participants and have the "Inform Consent" signed; 5) recruited 350 participants from 18 Track and field varsity teams; 6) delivering the "Questionnaire" to the participants. Except for marathon, race-walking, pole-vaulting, hammer, female heptathlon and male decathlon,

the events of these collegiate athletes included all the events that been held in the International University Track and Field Championship.

As a result, 350 athletes filled out the questionnaire, and 283 athletes (159 male, 124 female) correctly answered and returned the questionnaire to their coaches (return rate 81 %). Of which first-year collegiate athletes were 68 / 24 %; second-year collegiate athletes were 94 / 33 %; three & more years were 121 / 43 %. Furthermore, Athlete-Grade three were 39 / 14 %; Athlete-Grade two were 135 / 48%, and the Elite and the Grade-one athletes' combination group* were 109 / 38 % (*because the Grade one has particular reasons, this combination group represent the competitive level of each team). The all selected colleges and universities in the current study are under the administration of the Federation of University Sport of China (FUSC, 2018), and the FUSC has 15 branches – Track and Field is one of these branches, named the Track and Field Federation of University Sport of China (TFFUSC, 2018). All national and international collegiate track and field competitions and championships held in China were governed by the TFFUSC.

Research design

The following specific research hypotheses and questions guided this study: (1) no significant differences exist on the motivation factors between the 'gender' (male, female) 'disciplines' (natural science, social science), 'financing supports' (by-parents or by-school)? (2) No significant differences would be found on the motivation factors among the collegiate athletes who's 'year in the college' (1 year, 2 years, 3 and more years); 'Athlete-Grades' (Grade 1, Grade 2, Grade 3); 'original motivation' (for-professional, for non-professional, for extra-credits)? (3) What would be the current health-related behaviors status of the participant? To answer the above questions, the data analyses included descriptive statistics, reliability analysis and a $2 \times 2 \times 2$ Gender (male or female) x Disciplines (natural science or social science) x Financing supported (by parents or by school); and a $3 \times 3 \times 3$ [Year in the college (One year, Two years, Three and more years) x Athletics Grades (Grade 1, Grade 2, Grade 3) x Original Motivations (for-professional, for non-professional, for extra-credits)] factorial multivariate analysis of variance (MANOVA). The statistical program used for the data analysis was the IBM Statistical Package for the Social Sciences (SPSS) Version 25.

3. Results

All the results were summarized in Table 1 to Table 6. It aims at revealing what factors or reasons motivated these collegiate athletes (CAs) engaged in the sport of T & F and revealing the status of their health-related behavior. Of the 350 questionnaires distributed, 283 were completed correctly and returned to the researcher. The return rate is 81 %. Data in Table 1 reflected "General Information of the participants".

Number / Questions	Answers / Frequency / Pe	ercentage				
1. What is your gender?	Male= 159 / 56.79%	Female = 121 / 43.21%				
2. What is your BMI? ^{Note}	Answer for male: Mean BMI = $24.13 (\pm 2.07)$					
	Answer for	r female: Mean BMI = $21.87 (\pm 2.31)$				
3. What is your year in college / u	university?					
	Freshmen = 65 / 22.97%	Sophomore = 99 / 34.98%				
	Junior = 56 / 19.79%	Senior / \hat{G} raduate = 60 / 21.20%				
4. How long have you officially p	racticed Track & Field?					
(One year = $30 / 10.60\%$	Two years $= 41 / 14.49\%$				
r.	Three year = $90 / 31.80\%$	Four or more years = $122 / 43.211\%$				
5. What is your Athletics-class?						
a) El	lite / master = $18 / 6.36\%$	b) First-class = $91/32.15\%$				
c) Se	econd-class = 135 / 47.70%	d) Third-class = $39/13.78\%$				
6. Financially, who supported you	engaged in Track & Field p	ractices and competitions?				
a) My p	parents $= 87 / 31.07\%$	b) my school / team $= 176/62.86\%$				
c) By m	yself = 17 / 6.07	d) sport club = $0 / 0\%$				
7. Which science your major in?		_				

Table 1. General Information about the Participants (N = 283, 159 Male, 124 Female)

a) Natural science = 10236.43% b) Social science = 178/ 63.57% 8. What reason or factor originally motivated you participated in track & field competition? a) For become a professional athletes = 69 /24.89% b) For go to a good college / university =108 /38.57% c) For become a non-professional athletes but a stronger person = 78 / 27.86% d) For others reasons = 25 / 8.93%

Note. The BMI were calculated using the formula of $kg/m^{\scriptscriptstyle 2}$

Mean scores and the standard deviations of the motivation factors (MF) that motivated these collegiate T & F athletes are presented in Table 2; the ranks of the mean scores of the 19 MFs' are also presented in Table 2.

Table 2. Motivation factors (MF) that motivated the collegiate T & F athletes: Means score and Standard deviations (S.D); (N = 283, 159 Male, 124 Female)

Motivation Factors (MF)	Mean \pm S.D.	Sum	Rank
MF 1 Because T & F high technical content and unique value.	3.852 ± 1.070	1090.00	2
MF 2 For the fun and get rid of boredom.	$3.759 \pm .925$	1064.00	4
MF 3 For getting healthier whole body	$3.583 \pm .868$	1086.00	9
MF 4 For the enjoyment and have happiness.	$3.583 \pm .926$	1014.00	10
MF 5 In order to meet my friends.	3.481 ± 1.069	985.00	15
MF 6 In order to make new friends.	3.583 ± 1.019	1014.00	11
MF 7 In order to contest winners.	$3.583 \pm .907$	1014.00	12
MF 8 In order to shape the body.	3.652 ± 1.011	1062.00	7
MF 9 In order to improve physical health.	3.738 ± 1.029	1058.00	5
MF 10 For the near future may become a professional athlete.	3.795 ± 1.078	1074.00	3
MF 11 In order to foster self-esteem.	3.583 ± 1.012	1014.00	13
MF 12 In order to improve my own reputation	$4.042 \pm \! 1.574$	1144.00	1
MF 13 In order to establish prestige among my friends.	3.374 ± 1.092	955.00	16
MF 14 In order to get the recognition from my teacher / coach.	3.368 ± 1.071	1010.00	17
MF 15 In order to reduce the learning / working pressure.	3.516 ± 1.018	998.00	14
MF 16 In order to reduce the troubles from learning / work.	3.661 ± 1.023	1036.00	8
MF 17 In order to develop a unique sport skill.	3.692 ± 1.088	1045.00	6
MF 18 Hope to become a T &F coach in the future.	3.049 ± 1.405	863.00	18
MF 19 In order to satisfy the will of family.	2.625 ± 1.350	743.00	19

Note. a) The motivation factor (MF) 1, 2, 4, 7, 8, 10, 13, 14, 15, and 17 are 'Intrinsic motivation factors'; b) the MF 3, 5, 6, 9, 11, 12, 16, 18, and 19 are 'Extrinsic motivation factors'.

As showed in Table 2, the top six MFs were MF 12 'to improve reputation' (M = 4.042); MF 1 'high technical content and unique value' (M = 3.852); MF 10 'for become a professional' (M = 3.795); MF 2 'For fun & get rid of boredom' (M = 3.759); MF 9 'for improve physical health' (M = 3.738); and MF 17 'for develop a unique sport skill' (M = 3.692), These six factors possessed the highest impact power on these collegiate athletes' motivation. The bottom seven factors were MF 11 'for foster self-esteem' (M = 3.583), MF 15 'for reduce the learning / working pressure' (M = 3.516); MF 5 'for meet my friends' (M = 3.481); MF 13 'for establishing prestige' (M = 3.374); MF 14 'to get the recognition' (M = 3.368), MF 18 'to become a T&F coach' (M = 3.049); and MF 19 'to satisfy the will of family' (M = 2.625); these seven factors possessed less or lowest impact power on these collegiate athletes' motivation. The other six factors' mean score was at the medium level. These MFs were: MF 8 'to shape the body'; MF 16 'to reduce the troubles from learning/work'; MF 3 'for getting healthier whole body', MF 4 'for the enjoyment and have happiness'; MF 6 'to make new friends'; and MF 7 'to contest winners'. The mean scores were from 3.583 to 3.652. These six factors possess a medium impact power on these collegiate athletes' motivation. The results of the 2 x 2 x 2 and a 3 x 3 x 3 MANOVA for comparing the motivational factors for the collegiate T & F athletes are presented in Table 3.

Table 3. The 2 x 2 x 2 (*Gender*: male, female) x (*Disciplines*: natural-science, social-science) x (*Financing Supports*: by parents, by school); and a 3 x 3 x 3(*Years in College*: 1 year, 2 years, 3 & more years) x (*Athletic-Grades*: Grade 1, Grade 2, Grade 3) x 3 (*Original Motivations*: for professional-athlete, for non-professional-athlete, for extra-credits) factorial MANOVA of the participants' motivation factors (N = 283, 159 Male, 124 Female).

Source	Wilks' Lambda	F	Hypo df	Error df	P	
Gender	.869	2.029 ^b	19.000	256.000	.008**	
Disciplines	.917	1.216 ^b	19.000	256.000	.244	
Financing support	.892	1.626b	19.000	256.000	.050*	
Years in college	.267	1.964	38.000	482.000	.001**	
Athletics-Grade	.783	1.645	38.000	480.000	.011*	
Original Motivations	.852	1.052b	38.000	480.000	.389	

Note. b. Exact statistic; c. Computed using alpha = .05

The results of the 2 x 2 x 2 MANOVA in Table 3 showed that: no significant difference in the 'Disciplines' aspect (p > .05), $\Lambda = .917$, F = 1.216; however, significant differences effect was found in the 'Gender' aspect (p < .008), $\Lambda = .869$, F = 2.029. And the 3 x 3 x 3 MANOVA in Table 3 also showed that: no significant difference in the 'Original Motivations' aspect (p > .05), $\Lambda = .852$, F = 1.052; however, significant differences effect was found in the 'Years in college' aspect (p < .001), $\Lambda = .267$, F = 1.964. According to the research design, after the effect of the significant difference was found, the follow-up MANOVA was conducted. Data presenting in Table 4 and Table 5 were from the follow-up MANOVA, its determined what "Motivation Factors" really had differences and reflected the "Factors that truly motivated the collegiate athletes to continually engage in T & F practices and competitions."

Table 4. Descriptive statistics of the collegiate T & F athletes' motivation factors after significant differences showed in *Gender and Financing-support* (N = 283)

Motivations	Gen	der Mean (SD)	Financing-su	pport Mean (SD)
Factors (MF)	Female (n=124)	vs. Male (<i>n</i> =159)	By Parents $(n=88)$ v	vs. By School $(n=165)$
MF1.	3.854 ±1.138	3.849 ± 1.026	3.652 ±1.119	4.115 ± .955*
MF2.	3.758 ± 1.038	$3.761 \pm .830$	$3.683 \pm .924$	$3.861 \pm .921*$
MF3.	$3.927 \pm .866*$	$3.767 \pm .865$	$3.826\pm\ .870$	$3.852 ~\pm~ .868$
MF4.	3.613 ± 1.116	$3.559 \pm .875$	$3.552 \pm .967$	3.623 ± 1.015
MF5.	3.484 ± 1.107	3.478 ± 1.042	3.484 ± 1.090	$3.478 \ \pm 1.046$
MF6.	3.506 ± 1.081	$3.572 \pm .971$	3.521 ± 1.006	3.664 ± 1.033
MF7.	$3.911 \pm .987*$	$3.635 \pm .822$	$3.670 \pm .857$	$3.869 \pm .961*$
MF8.	3.629 ± 1.115	$3.849 \pm .915*$	$3.795 \pm .962$	$3.696 \ \pm 1.074$
MF9.	3.742 ± 1.058	3.735 ± 1.009	3.708 ± 1.052	$3.778 \ \pm 1.000$
MF10.	3.604 ± 1.174	$3.043 \pm .975*$	3.813 ± 1.079	$3.770 \ \pm 1.081$
MF11.	3.572 ± 1.098	$3.591 \pm .942$	3.540 ± 1.042	$3.639 ~\pm~ .971$
MF12.	3.702 ± 1.035	$4.308 \pm 1.067*$	3.956 ± 1.087	$4.155 \ \pm 1.079 *$
MF13.	3.209 ± 1.113	$3.503 \pm 1.060*$	3.329 ± 1.128	$3.347 \ \pm 1.073$
MF14	3.427 ± 1.176	$3.679 \pm .969*$	3.509 ± 1.067	$3.647 \ \pm 1.075$
MF15.	3.492 ± 1.093	$3.553 \pm .958$	3.472 ± 1.019	$3.598 \ \pm 1.017$
MF16.	3.524 ± 1.077	$3.767 \pm .969*$	3.633 ± 1.034	3.697 ± 1.011
MF17.	3.685 ± 1.114	$3.698 \pm 1.071 *$	3.577 ± 1.116	$3.844 \pm 1.036*$

	European J	European Journal of Physical Education and Sport, 2019, 7(1)				
MF18. MF19.	3.363 ± 1.308 $2.846 \pm 1.402*$	$2.805 \pm 1.434*$ 2.453 ± 1.286	$\begin{array}{c} 2.882 \pm \!$	$\begin{array}{r} 3.271 \ \pm 1.366 * \\ 2.647 \ \pm 1.207 \end{array}$		

Note. There are results from the follow-up test: a) In 'Gender' aspect, 11 out of 19 comparisons showed significant differences at p < .05*level; and b) In 'Financing-support' aspect, 6 out of 19 comparisons showed significant differences at p < .05*level.

Table 5. Descriptive statistics of the collegiate T & F athletes' motivation factors after significant differences showed in *Years in college and Athletics-classe* (N = 283, 159 Male, 124 Female)

MF	F Years in college Mean (SD)			Athletic-Grades Mean (SD)			
	1 year (<i>n</i> =68)	2 years (n=94)	3+ years (n=121)	Grade-1 (<i>n=109</i>)	Grade-2 (<i>n</i> =135)	Grade-3 (<i>n=39</i>)	
MF1.	3.662 ±1.216	4.085 ± .946*	3.776±1.060	4.119 ± .997*	3.755 ±1.054	3.435 ±1.187	
MF2.	3.706 ± .993	3.893 ± .901	3.686±.875	3.779 ± .984	3.829 ± .842*	3.461 ± .996	
MF3.	$4.014 \pm .849^*$	3.808 ± .871	3.760±.885	3.893 ± .901	3.815 ± .857	$3.871 \pm .832$	
MF4.	3.647 ±1.033	3.755 ± .900*	3.413 ±1.000	3.559 ±1.057	3.652 ± .900*	3.410 ±1.069	
MF5.	3.397 ±1.211	3.628 ± .938*	3.413 ±1.077	3.413 ±1.082	3.518 ±1.013	3.538 ±1.232	
MF6.	3.609 ±1.134	3.723 ± .932*	3.462±1.001	3.541 ±1.032	3.629 ± .959	3.538 ±1.188	
MF7.	$3.926 \pm .869^*$	3.755 ± .876*	3.661 ± .944	3.853 ±.921	3.718 ± .886	3.615 ± .935	
MF8.	3.838 ± .940	3.829 ± .979*	3.644 ±1.071	3.642 ±1.093	3.889 ± .886*	3.589 ±1.140	
MF9.	3.764 ±1.052	3.797 ± .979	3.677 ±1.058	3.853 ±1.052*	3.644 ± .949	3.743 ±1.207	
MF10.	3.882±1.139	3.915 ± .946*	3.653 ± 1.130	3.825 ±1.052	3.718 ±1.090	3.974 ±1.111	
MF11.	3.632±1.049	3.648 ± .958*	3.504 ±1.033	3.706 ±1.011*	3.459 ±1.027	3.667 ± .927	
MF12.	4.558±1.566*	3.776 ± .857	3.958±1.493	3.963 ±1.442	4.237 ±1.338*	3.589 ± .818	
MF13.	3.338±1.154	3.553 ±1.053*	3.256±1.076	3.403 ±1.114	3.331 ±1.054	3.512 ±1.166	
MF14.	3.603±1.108	3.861 ± .945*	3.322 ±1.089	3.614 ±1.104*	3.563 ±1.026	3.461 ±1.143	
MF15.	3.514±1.085	3.744 ± .815*	3.363±1.095	3.651 ±1.021*	3.488 ±.991	3.308 ±1.079	
MF16.	3.647±1.075	3.862 ± .887*	3.512±1.073	3.697 ±.976	3.681 ±1.048	3.487 ±1.073	
MF17.	3.721±1.130	3.766 ±1.041	3.619±1.105	3.779 ±1.083*	3.637 ±1.076	3.641 ±1.158	
MF18.	3.220±1.347*	2.946 ±1.401	3.033 ±1.442	3.275 ±1.346*	2.881 ±1.425	3.000 ±1.451	
MF19.	2.558 ± 1.320	2.553 ±1.395	2.719±1.336	2.752 ±1.375	2.525 ±1.343	2.615 ±1.311	

Note. There are results from the follow-up test: a) In 'Years in college ' aspect, 16 comparisons reached significant differences at p < .05*level. b) In 'Athletics-classes' aspect, 11 comparisons reached significant differences at p < .05* level

The findings from the Part III of the QCAPMHRB (Zeng, 2019) including four sub-categories such as, 'Eating Habits', Nutrition Knowledge and Status', 'Risk Behaviours', and 'Hygiene Behaviors' involved a total of 27 health-related behaviors as presented in Table 6.

Table 6. Summerize of collegiate T & F athletes' health-related behaviors in Part III of the QCAMHRB (*N* = 283, 159 Male, 124 Female)

Behaviore catogories	Anwser / Ferency and Percentage			
Sub-category one. The 'Eating habits'				
1. Do you eat regularly?				
a) My eating is very regular (201 / 71.02%)	b) My eating is regular (51/14.43%)			
c) My eating is unregularly (31/10.95%)	d) My eating is very unregularly $(0/0\%)$			
2. How many meals do you eat a day?				
a) Less than 3 times per day $(0/0\%)$	b) 3 times per day (223/78.79%)			
c) 4-5 times per day $(49/17.31\%)$	d) Others (11 / 3.89%)			
3. Do you add salt to your dishes?				
a) Yes, always $(0/0\%)$	b) Sometimes, yes (109/38.51%)			
c) Sometimes - no (168/ 59.36%)	d) No, I never $(6/2.12\%)$			
4. Do you try to cut down on the amount of sugars you e	eat?			

a) Yes (56 / 19.79%) b) Sometimes - no (145 / 51.12%) c) Sometimes - yes (135/47.78%) d) No, I don't (87 / 30.74%) 5. How many glasses of milk or dairy products (yoghurt, juce) do you drink per day? a) 1-2 cups (139 / 49.12%) b) 3-4 cups (68 / 24.03%) c) more than 5 cups (7/2.47%)d) I don' drink milk but yoghurt (69 / 24.38%) 6. Do you dine before and after strenuous exercise? a) Yes (0/0%)b) Sometimes I do (0/0%)c) I occasionally do (16/ 5.56%) d) I never do so (267/94.34%)Sub-category two. 'Nutrition knowledge and status' 7. How is your knowledge status about nutrition? a) Very good (89 / 31.76%) b) Good (182/64.31%) c) Ordinary (12/4.24%)d) Not so good (0 / 0%)8. How often do you eat fruit? a) Once per day (99/34.98%) b) Twice per day (128 / 45.23%)c) More than three times per day (0/0%)d) Once every other day (56 / 19.78%)9. How often do you eat vegetables? a) Once per day (0/0%)b) Twice per day (215 / 75.97%) c) Three times per day (68 / 24.03%) d) Once every other day (0/0%)10. How often do you eat fish? a) Once per day (45 / 15.90%)b) Twice per day (0/0%)c) Three times per day (0/0%)d) Twice per week (238 / 84.10%) 11. Do you eat wholemeal bread? Yes: a) Once per day (162 / 57.24%)b) Twice per day (48 / 16.96%) c) Three times per day (0/0%)d) Once every other day (73 / 25.79%)12. How many times do you eat dinner with meat in a week? a) 1-2 times (0/0%)b) 3-4 times (0/0%)c) more than 4 times (189 / 66.78%)d) every day in a week (94/33.22%)13. What is your favourite meat? a) Chicken (99 / 34.98%) b) Pork (81 / 28.62%) c) Veal / Calf (78 / 27.65%) d) Mutton / Lamb (25 / 8.83%) 14. Do you eat fried foods? a) Occasionally eat (89/34.45%)b) Sometimes eat (138 / 48.76%) c) Yes I like eat fried foods (45 / 15.90%) d) No, I do not eat fried food (11 / 3.89%) Sub-category three. 'Risk behaviour' 15. How often do you drink alcohol? a) Never (45 / 15.90%) b) Seldom (76 / 26.85%) c) Once in a while (79 / 27.92%) d) whenever have a reason (83 / 29.33%) 16. Do you smoke cigarettes? a) Never (112 / 39.58%) b) seldom (157 / 55.48%) c) Once in a while (9/3.18%)d) whenever have a reason (5 / 1.77%)17. Do you use any psychoactive substances? a) Never (283/100%) b) seldom (0 / 0%)d) whenever have a reason (0 / 0%)c) once in a while (0 / 0%)18. Did you use anabolic steroid? a) Never (283 / 100%) b) seldom (0 / 0%)c) once in a while (0/0%)d) whenever have a reason (0 / 0%)19. Do you know what health consequences to applying prohibited anabolic steroid or different kind of doping substances? a) Yes, I know them well (178 / 62.90%)b) Yes, I know some of them (91 / 32.15%) c) No, I am not sure (14 / 4.95%) d) No, I don't know them at all (0 / 0%)Sub-category four. 'Hygiene behaviours' 20. Do you use sun cream when you practice in T&F? a) Never (45 / 15.90%) b) seldom (49 / 19.4%) c) once in a while (91 / 32.15%) d) whenever have a reason (98/34.63%)

21. Do you take a shower after practicing or competition	?
a) Yes, of cause I do (269 / 95.0	b) No (14 / 4.95%), just
want to back to my dorm.	
c) Mostof time I do $(0 / 0\%)$	d) No, because I do not want to $(0 / 0\%)$
22. How often do you wash your hands daily?	
a) One time $(0 / \%)$	b) Two to three times $(0/0\%)$
c) Before every meal (189 / 66.78 %)	d) Whenever it is need to $(94 / 32.22\%)$
23. How often do you brush your teeth daily?	
a) Once per day $(0/0\%)$	b) Twice per day (159 / 56.18%)
c) Three times per day $(124 / 43.82\%)$	d) Never (0 / %)
24. Do you use extra hygiene mouth? (If a 'Yes' circle the things you used):	
a) Dentist's threads (81 / 28.62%)	b) Teeth Liquids to rinsing (68 / 24.03%)
c) Dental floss (89 / 31.45%)	d) No, I never use extra hygiene mouth
(48/16.96%)	
25. After a intensive practice, how was the quality of your sleep?	
a) Very good (77 / 27.21%)	b) Good (89/31.45%)
c) Normal (59 / 20.85%)	d) Not so good (58 / 20.49%)
26. After a intensive competition, how is the quality of your sleep?	
a) Very good (66 / 23.32%)	b) Good (68/24.03%)
c) Normal (88/31.09%)	d) Not so good $(61 / 21.55\%)$
27. When sweating, do you drink water or beverages immediately?	
a) Yes, I drink water immediately (175 / 61.84%)	b) I don't drink any of them immediately $(0 / 0\%)$
c) I drink beverages immediately (86 / 30.39%)	d) I drink water but not immediately (22 / 7.77%)

Data presented in Table 6 reflected the precious features and current status of these collegiate T&F athletes' health-related behaviors. The researchers believe that these four sub-areas of health-related behaviors are very important to these collegiate T&F athletes and possess a positive relationship with their success rate during the collegiate athletes period. That is, the better their health-related behaviors, the higher the success rate for them to become elite collegiate athletes. Furthermore, these findings worth coaches, trainers, teachers, and administrators who have been worked for the collegiate athletes to pay closer attention, and really figure out the ways to educate and reinforce their collegiate athletes students to gradually develop positive health-related behaviors, so that the athletes from the day one of he/she represent his/her college/university clearly know that gradually develop a positive participation motivations and health-related behaviors are two very important factors during they compete in the collegiate athletes level.

The following are the most significant findings highlighted from Table 6: 1) 85 % of them eat regularly to very regularly. 2) 96 % of them eat three meals or more per day. 3) 38 % of them did add salt to their dishes but 59% of them did not. 4) About 68 % of them did try to reduce the number of sugars they eat. 5) 76 % of them drink one to five cups of milk/yoghurt/ juice per day. 6) 94% of them reported they never eat before and after strenuous exercise. 7) 96 % of them reported they possess good to very good nutrition knowledge. 8) 80 % of them claimed they eat fruit every day. 9) 100 % of them reported they eat vegetables every day. 10) 100 % of them reported they eat fish but 16% of them ate fish once per day and 20 % of them said they eat fish once every other day. 11) 74 % of them reported they eat whole meal bread; 12) 100 % of them reported they eat dinner with meat at least four days per week. 13) 35 % in favor eat chicken, 29 % in favor eat pork, 28 % in favor eat Veal / Calf, and 9% in favor eat Mutton / Lamb. 14) 96 % of them reported they eat fried foods. 15) 84 % of them admitted they drink alcohol; 16) 40 % of them reported they never smoke cigarettes, but 60 % of them admitted they smoke cigarettes. 17) 100 % of them said they never use any psychoactive substances. 18) 100% of them said they never use anabolic steroids; 19) 95 % of them reported they know the health consequences of using the prohibited anabolic steroid. 20) 84 % of them claimed they use sun cream during their practice/competition. 21) 95 % of them said they take a shower after practicing or competition. 22) 100 % of them reported they wash their hands before eating or whenever it is needed. 23) 100 % of them claimed they brush teeth 2-3 times per day. 24) 87 % of them said they use extra hygiene mouth. 25) About 80 % of them claimed they had normal to a good sleep after an intensive practice. 26) About 22 % of them claimed they did not have good sleep after an intensive competition. 27) 62 % of them said that when they sweat they drink water immediately, and 30 % of them said they drink beverages immediately (As described in Table 6).

4. Discussion

The present study was designed for 1) exploring the current status and features of the collegiate T&F athletes' participation motivations from a selected regional conference; 2) examining if differences exist on the MFs among the participants' *'Gender', 'Disciplines' 'Financing support'. 'Years in College', 'Athlete-Grade', and 'Original motivations'*; and 3) investigating the current status of health-related behaviors of these collegiate athletes.

First, according to the data exhibited in Table 2, the scores placements can be divided into three groups: 1) The high impact factors group, containing MF12, MF1, MF10, F2, MF9, MF17, and these six FMs possessed the highest score and impact power on this collegiate athletes' motivation. Interestingly, among these six MFs, the MF1, MF10, FM2, and MF17 are in the 'Intrinsic factors' category, while the MF12 and MF9 are in 'Extrinsic factors' category. Second, the medium impact MFs group with medium-high scores, containing MF8, MF16, MF3, MF4, MF6, and MF7, possessed medium impact power on these collegiate athletes' motivation. Different from the first group, this group has two MFs (that are MFs 8, 6) belong to the 'Intrinsic factors' category; but contain four MFs (that are MFs 16, 3, 6, and 11) belong to the 'Extrinsic factors' category. Third, the lower impact MFs group, consisting of MF11, MF15, MF13, MF14, MF5, MF18, and MF19 (with lowest scores), possessed significantly lower impact power on these participants' motivations. Incredibly, there are four MFs belong to the 'Extrinsic factors' category (MFs 11, 5, 18, and 19); while containing three MFs from the 'Intrinsic factors' category (MFs 13, 14, and 15).

In summary, 1) with regard to this sample's participation motivation features, both 'Intrinsic factors' and 'Extrinsic factors' possess a quite similar impact power on their motivations; but with the 2) 'Intrinsic factors' possess slightly stronger impact power than those of the 'Extrinsic factors'. It can be concluded that: the ten 'Intrinsic factors' in the QCAPMHRB (Zeng, 2019) were the core motivation factors for these collegiate athletes. 3) There are some factors or reasons that possessed a higher impact power than the other factors, and some factors or reasons possessed less impact power than the other factors as well. Based on the findings from the present study, the collegiate athletes' coaches, trainers or administrators should diagnose and analyze their athletes' specific situation and implement the findings accordingly.

Furthermore, the two after significant findings follow up MANOVA test revealed that: 11 out of 19 comparisons in the 'Gender' aspect showed significant differences at p < .05 level. First, females scored significantly higher than males in the following three MFs: MF3 'getting healthier whole body'; MF7 'contest winners' and MF19 'satisfy family will '. These three MFs exactly reflected the characteristics of females in value higher in 'healthier whole body', 'family-will', and 'winning or lost'. Second, there were eight MFs reached p < .05 level with male scored significantly higher than females that were: MF8 'shape the body'; MF10 'become a professional athlete'; MF12 'improve my own reputation'; MF 13 'establish prestige' among friends; MF14 'get the recognition'; MF16 'reduce the troubles from learning/work' MF 17 'develop a unique sport skill'; and MF 18 'become a T & F coach in the future'. It is understandable that when these male athletes were facing these eight MFs, their reaction or responses were different from their female teammates, these male athletes who were motivated by 'become a professional' and 'become a T & F coach' were much more exciting, because these athletes possessed more competition experience, higher athletics-level, and stronger feelings, and that were true motivation factors have driven them to involve T&F practices and competitions for years. Moreover, these athletes were also serious on 'getting extra credits' for their future, because in the near future their athletics achievement might beneficial for them to get into their ideal job, etc. (As described in Tables 4 and 5)

On the other hand, the second after significant findings follow up MANOVA test revealed that: there were 16 out of 19 comparisons reached significant differences at p < .05 level in 'Year in college' aspect. Wherein the '2 years' group scored significantly higher than that of '1 year' and '3/more years' group in MF1 'high technical content and unique value', MF4 'enjoyment and happiness', MF5 'meet friends', MF6 'to make new friends', MF7 'contest winners', MF8 'shape the body', MF10 'become a professional athlete', M11 'foster self-esteem', MF13 'establish prestige' among friends', MF14 'get the recognition', MF15 'reduce pressure'', MF16 'reduce the troubles

from learning/work'. While there were the following four MFs in the '1 year' group scored significant higher than the 'two years' group and 'three/more years': MF3 'getting healthier whole body', MF7 'contest winners', MF12 'improve my own reputation', and 'become a T&F coach in the future'. It is understandable that the 'one-year' group is more care about 'getting healthier body', 'winning or lost', 'improve reputation', and to 'become a T&F coach' than the other years' groups.

Last, with regard to the 11 out of 19 comparisons reached significant differences at p < .05 level in 'Athletic-Grades', the Grade-one group (The highest athletics level in this sample) is much mature athlete students in terms of their athletic and academic performance. This group score much higher than those of 'level 2' and 'level 3' group in MF1 'high technical content and unique value', MF9 'to improve physical health', MF11 'to foster self-esteem', MF14 'to get the recognition', MF15. 'to reduce pressure', MF17. 'to develop a unique sport skill', and MF18 'to become a coach in the future'. Findings support that, the athletes in the 'Grade one' group were much more appreciative of the 'T&F" with 'high technical content and unique value', and want to become a T&F coach after they graduate.

Interestingly, in the following FMs the 'Grade two" group scored significantly higher than 'Grade one' and 'Grade 3' groups in MF2 'for the fun and get rid of boredom', MF4 'for enjoyment and happiness', MF8 'to shape the body', and MF12 'to improve my own reputation'. It is not difficult to find out that those are more external driven powers work for them, reflecting this level of athletes need to 'have fun', 'enjoyment', 'happiness', 'good body shape' and a 'good reputation' supported them to continually participate in their practices and competitions, etc. (see Table 5 for detail)

Jeffery and Camiré (2016) indicated that student-athletes engaged in the sports they like having a response: first is to satisfy their needs for autonomy, competence, and relatedness. Second, motivations to participate in a sport for certain periods of time are a complex combination of intrinsic and extrinsic motivations and not a simple type of motivation (Jeffery, Camiré, 2016). Participation in sports practices and competition during the college/university years helped the student-athletes gain the knowledge and understanding the need for their future career decisions and able to develop a willingness for long-term participation (Jeffery, Camiré, 2016). First, which are highly consistent with our findings on the three needs: 1) autonomy, 2) competence, and 3) relatedness. Second, the present study also indicated that the selected collegiate athletes were motivated by both intrinsic and extrinsic motivations. Moreover, the present study also provided specific factors/data supported by different genders and different athlete-grades or levels of collegiate athletes who need different MFs to drive and stimulate them to continually participate in their T&F practices and competitions.

Kilpatrick and Bartholomew (2010) stated that college-students participant in sports was more likely to relate to intrinsic motivations, such as enjoyment and challenge, while for physical exercises were more tend to be extrinsic motivations such as focused on appearance and weight and stress management. The researchers suggest that for motivating collegiate athletes' participation, the coachers or athletics advisers need to do more in deeper understand their needs that may generate more appropriate advice or recommendations (Kilpatrick, Bartholomew, 2010).

As presented above, although our study and their study were conducted in different sports events and counties, the findings have many similarities. Specifically, top to medium influence power factors or reasons for the collegiate-athletes keeping engaged in the sports they like were similar. Meanwhile, when contrasting the factors or reasons of 'feeling important and popular', 'earning rewards', 'team atmosphere' and 'good relationship with coach' from the previous studies with the factors of 'technical content and unique value', 'unique skills', 'for fun', 'for establish prestige', 'become a professional athlete', 'for self-esteem', 'to contest winners', and 'become a coach'; many differences between their studies and our study are exist.

Regard to athletes' health-related behaviors, Diehl, K., et al. (2012) conducted a profound review of literature in athletes' eating behaviors, the researchers summarized that: Many studies reported that the eating behavior of athletes was healthier in some respects than those of nonathletes or less athletic young peoples; and Several large studies demonstrated that athletes selfreported they were in favor eating fruit and vegetable (Diehl et al., 2012). The researcher also summarized that both high-involved athletes and low-involved athletes had macro- and micronutrient intakes below recommended levels for essential minerals, carbohydrates, and overall caloric intake (Diehl et al., 2012) As to the 'performance-enhancing drug use', the research stated that Performance-enhancing drug use was discussed in 16 articles. The prevalence of ever having used anabolic steroids ranged between 2 % and 6 % with a combined prevalence of 4 %, and the researchers further indicated that the prevalence increased by the level of competition. Young adolescents engaged in strength training football and weight-dependent sports were more likely to use anabolic steroids than athletes engaged in other kinds of sport (Diehl et al., 2012). The researchers concluded that: 1) athletes were more likely to consume alcohol, smokeless tobacco, and steroids than non-athletes; and 2) athletes were less likely to smoke and to use marihuana than non-athletes (Diehl et al., 2012).

Our study did an exploring investigation in the area of athletes' health-related behaviors; because this an initial try, its design, data collection and analyses are far from perfection. However, it should be a good start for notifying researchers to pay attention to health-related behaviors study in the domain of collegiate athletics research. To the results presented in Table 6, we cannot accurately make an assessment on how good or not about their 'Health-Related Behaviors', but the findings in Table 6 did reflect the current status of 'Health-Related Behaviors' of the participants. Generally speaking, when using four points of "Excellent [4], Very-good [3], Good [2], and Not so good [1], then, their overall status should be on the position between excellent and very good of the scale.

What does that mean? It means 1) during their practices and competitions these collegiateathletes had obtained positive and corrective education in 'Eating habits', 'Nutrition knowledge', 'Risk behaviors', and 'Hygiene behaviors' from their coaches, academic advisers, and administrators. 2) There are rooms for improvement regarding these collegiate-athletes although their status was pretty good. 3) The results of the assessments have also indirectly reflected these collegiate-athletes teams/colleges/universities have strict regulations or legislation to manage their athletes' daily life. From the health education perspective, we believe that is a positive and beautiful thing deserves to recommend to the other collegiate-athletes. With this consideration, this point is consistent with the point of a literature review article by Geidne, Quennerstedt, and Eriksson (2013); the researchers indicated that with regard to building healthy public policy, youth sports teams/schools should recognize and match up with the changes in regulations or legislation at a central level, and then carry out these regulations or legislation to different types of teams or schools. All of these changes in legislation, organization, or policies there is one thing in common: that is put health on the agenda (Geidne et al., 2013).

5. Conclusion

With respect to the research questions that guided this study, the findings revealed that: (1) No significant difference in the 'Disciplines' aspect (p > .05), however, significant differences effect was found in the 'Gender' aspect (p < .008). (2) Findings verified that no significant differences in the 'Original motivation' aspect (p > .05), however, significant differences effect was found in the 'Year in the college/university' (p < .001) and 'Athletics-Grades' aspects (p < .011). (3) Regarding "what would be the current health-related behaviors status of the participant? Table 6 provides detail pieces of evidence, and in the discussion section, more reasons behind the findings are also illustrated and discussed.

In conclusion, (1) the findings of this investigation exposed: 'Disciplines' and 'Original motivation' are not the determine aspects; but the 'Gender' 'Financing supported', 'Years in the college/university', and 'Athlete-Grades' aspects are. (2) Male CT&FAs possesses higher participation motivations than female CT&FAs. (3) Financing supported by college/university possess higher participation motivations than those of supporting by parent. (4) Those athletes who in their first and second years possess higher participation motivations than those of supporting by parent. (4) Those athletes who in their third or 4th years. (5) Athletes who possess higher 'Athlete-Grades' also possess higher participation motivations. (6) As to the types of motivations, those 'Intrinsic factors' possess slightly higher impact power than those of the 'Extrinsic factors' (As described in Table 2, 4 & 5). (7) With regard to the health-related behaviors, a qualitatively conclude can be made: the mean score of the participants' health-related behaviors for all 27 items were 3.5 – between the position of 'Excellent [4] and 'Very good' [3] by using a four points assessment scale (see Table 6).

6. Limitations

The following limitations have existed when we conducted this study: 1) the size of sampling

for reflecting the participation motivations status and health-related behaviors of CT&FAs was relatively small. 2) Coaches and academic advisers of the CT&FAs might have impact or influence on their athletes' participation motivations, such as Mageau and Vallerand (2003) described that along with the athletics training processes through which coachers behaviors may have generated a positive influence on athletes' intrinsic and self-determined extrinsic Motivation; but coachers behaviors were not be included in the objects of the present study. 3) The participants in the current study were selected on purpose. Future study can be improved on overcoming the above limitations by enlarging the sampling size, extend to more CT&FAs associations; and involving coaches and academic advisers of the select CT&FAs teams, this can be done by using some openended questions for the objects you want to cover.

7. Recommendations

The present study explored the CT&FAs' participation motivations and health-related behaviors from one particular collegiate athletics associations, the top 10 MFs for these collegiate athletes' engaged in track and field practices and competitions are: 'for improve reputation', 'technical content and unique value', 'to become a professional athlete', 'for fun and not boredom', 'to improve physical health' 'to develop a unique sport skill', 'to shape the body', 'to reduce troubles from learning / work', 'for getting healthier whole body', and 'for enjoyment and happiness'; and these 10 MFs have been found as the core value of these collegiate athletics' participation motivations. Other than that, the team atmosphere and good relationship between coaches and athletes also influenced these collegiate athletes' participation motivations. Moreover, although the values of collegiate athletes' participation motivations have been recognized by those previous sports researchers (e.g., Jeffery, Camiré, 2016; Kilpatrick et al., 2010; Xu et al., 2009; Zeng, 2019). Further studies, however, are definitely needed, especially in the area of how intrinsic motivation and extrinsic motivation work differently on different types of collegiate athletes; for example, a) athletes who competed in different types of track and field events; b) athletes who financing support by their parent or by the team they represent for. Additionally, the health-related behaviors were explored in the present study might be another topic for researchers who are interested in collegiate athletics to pay attention, because only those athletes who have developed their positive health-related behaviors during their collegiate years have a chance to 'become elite athletes' and reach their original goalsetting, 'become elite athletes' and academic successful college-students. To apply the findings of this investigation more effectively and accurately, collegiate athletics educators need to base on a profound diagnosis and analysis of their athletes' situations.

What does this article add?

The findings of the present investigation added a set of new data and information regarding the essential factors or reasons that motivated the CT&FAs to participate in T&F practices and competitions; the precious features about these CT&FAs' health-related behaviors are also identified. These findings provided examples and meaningful pieces of evidence for the coaches, instructors, and managers/administrators who want to reform or reinforce their collegiate athletics programs. If this can be done, it will lead to better coaching strategies, sport pedagogy, academic instruction, even all kinds of management strategies that need in the domain of collegiate athletics.

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