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ORIGINAL ARTICLE

BIO MOTORIC ANALYSIS, DEGENERATION PROCESS, AND ANXIETY OF PROFESSIONAL BOXER FOR MAXIMUM PEAK PERFORMANCE: A LITERATURE STUDY

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ABSTRACT

Background of study: The strength of a straight punch, uppercut and hook is needed by a professional boxer to knock down his opponent. Therefore, in the training program for a boxer, it is necessary to analyze the biomechanical characteristics and bio motoric components, which influence its, strength, endurance, and speed by not ignoring psychological factors and the degeneration process that occurs. Degeneration is a natural process, which occurs in every individual, from the cellular level to the level of movement. It functions since 30 years of age characterized by the disappearance of the ability of cells and tissues to repair and replace themselves and maintain normal structure, as well as resulting a decrease in all body functions for 1% every year **Methodology:** This article is a qualitative description with a literature study which analyzes various theories by experts in bio motoric components, degeneration processes, and psychological factors in the form of anxiety. **Result:** A balance between physical can slow the degeneration process, psychological, and environmental factors including the life style of a boxer, the factors of strength, endurance, speed, and psychological factors in the form of anxiety influence each other, both directly and indirectly against peak performance in the achievement of a boxer. **Conclusion:** Periodic measurements and evaluations of bio motoric components and mental training have to be considered, so that during the golden age, boxers can achieve optimally.

Keywords: Bio motoric, degeneration process, golden age, professional boxer.

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INTRODUCTION

Physical, psychological factors, and the social environment including the life style of boxers are very influential on achieving maximum performance (peak performance) during the productive age (golden age) as a professional boxer. A boxer has many hours of flying at least 100 amateur matches to become a professional competitive boxer. To become an Olympic champion, a boxer has to go through at least 200 amateur matches. In Indonesia, there are Chris John as a World Amateur (WA) super champion, David Jordan as International Boxing Organization (IBO) world champion, and the other champions, one of them is Gennady Gorlovka who have passed more than 300 amateur matches before becoming WA, World Boxing Council, International Boxing Federation and IBO world champions¹.

Physical condition must be considered a key factor for the success of a boxer. Physical condition is the level of physical ability with 10 bio motoric components, namely: strength, endurance, speed, explosive power, flexibility, balance, reaction time, agility, accuracy, and coordination^{2,3}. Empirical data says that the average boxers who become both amateur and professional, is underachieved and ended his class because of the influence from various internal and external factors. Internal factors of bio motoric components, which are closely

related to boxing, are strength, endurance, speed, degeneration process, and psychological factors namely anxiety. On the other side, external factors include nutrition intake and lifestyle, social environment, facilities, and guidance systems and training programs.

Strength factors (maximum strengths) include power or explosive strength (combined strength and speed), endurance (muscle and cardio respiration endurance) both anaerobic and aerobic, speed includes speed endurance and maximum speed with agility, coordination (perfect coordination), flexibility (full range of flexibility) are the five main elements of physical fitness (bio motor abilities) which need to be considered by an athlete including boxers⁴. Motion analysis and nutrient intake are also inseparable from boxing training programs to achieve maximum performance^{1,5}. Bone and joint elements, explosive power of muscle, energy availability, nutritional intake, biomechanical analysis, and motion patterns have an important role in producing a strong and well-targeted blow to win a match⁶.

A very important factor in boxing is the ability to hit your opponent. Straight, uppercut, and hook are very deadly blows to the opponent done with a technique accompanied by the right muscle explosive power with exerting full force. The strength of a straight punch,

uppercut and hook is needed by a boxer to knock down his opponent. Therefore, in a training program for a boxer, it is necessary to analyze the biomechanical characteristics and components that affect strength, endurance, speed, and the amount of energy required by a boxer including amount, composition, and time of food intake^{4,7}.

On the other hand, degeneration process always occurs in every individual, from the cellular level to the level of movement which functions in each activity carried out. This process affects all system functions existing in human body, which decreases by 1% per year⁵. Likewise, the musculoskeletal, other functions such as the neuromuscular, cardiorespiratory systems, digestive system, hormonal system, reflex system, and other body systems will also decrease their functions⁸.

Anxiety and stress are emotions experienced by everyone. Anxiety disorders are serious mental disorders, which causes major problems and brings crippling effects⁹. One of the psychiatric symptoms, which occurs in athletes, is anxiety¹⁰. Anxiety can arise at any time; one reason is excessive tension, which lasts, in a long time. Therefore, the events, which are important before, during, and at the end of a match in sports are strongly influenced by the level of anxiety of the sport, athletes, coaches,

referees, and spectators. Anxiety as one of the unique and interesting psychological studies often occurs in a boxer, especially before the match and when competing in the ring. Anxious feelings, which are caused by the shadow before the game and during the match occurs because of psychological stresses¹¹.

METHOD

The method used in the writing of this article is a qualitative description with a literature study which analyzes various theories by experts in bio motoric components, degeneration processes, and psychological factors in the form of anxiety. The anxiety which optimally affects the peak performance of professional boxers, is supported by empirical facts in the field.

DISCUSSION

Professional boxing is a popular global sport, which attracts huge interest and income. This is a high-intensity strenuous exercise requires a series of physiological characteristics, which are well adjusted as a prerequisite for achieving successful performance^{6,12}. This is inseparable from the aspects of strength, endurance, speed, and level of anxiety in matches. According to Satiadarma, peak performance is the optimum appearance achieved by an athlete¹³. Peak performance only opens up

greater opportunities for athletes to perform well in matches. Peak performance is the appearance or behavior that has optimized the potential of a person in a certain way so that it can produce achievements¹⁴.

Components of physical fitness that greatly influences a boxer in achieving maximum performance and achievement are strength (maximum strength) including power and muscle explosive power (strength and speed), endurance and cardio respiration both anaerobic and aerobic, and speed consisting of speed endurance and maximum speed including agility and reaction time⁴. These components are very important for a boxer in an exercise program to achieve maximum achievement during the golden age. On the other hand, the degeneration process always occurs naturally in every individual, from the cellular level to the level of movement and overall body function.

Strength

Muscle strength is the ability of the muscle to withstand a maximum load. Maximum strength is the highest strength that can be produced by the neuromuscular system during contractions^{6,15}. Physiologically, muscle strength is directly proportional to the volume or muscle size, the greater the muscle volume, the stronger the contraction that is produced to make a movement. The resulting

movements are the result of activation of the motor unit in the muscle. The motor unit is a motor neuron with all the muscle fibers which it supplies as the amount of muscle fiber per motor unit and the number of motor units per muscle varies¹⁶. One motor unit supplies 700 muscle fibers¹⁷. Rough and strong movements are produced by 1500-2000 muscle fibers. Thus, the more motor units that are recruited, the stronger the muscle contraction produced, so that the resulting movement becomes stronger⁸.

Muscle explosive power is the ability of the muscle to use the maximum power that is deployed in the shortest possible time. Power is the ability to make explosive movements in the shortest possible time, which is the result of integration of maximum strength and speed^{7,15}. The explosive power of the arm muscles is also the body's ability to allow the arm muscles to work exclusively. Muscle explosive power is a combination of strength and speed, where strength is the power or voltage that can be produced by the muscle in a contraction with maximum load, while speed is the ability to make successive movements in the shortest possible time. Thus the power is the maximum ability of muscles to carry out activities / movements with maximum load at a certain time unit. Factors that can influence muscle explosive power include intramuscular

factors consisting of cross-sectional area, muscle structure, available energy, muscle fiber type, and neural factors consisting of increased agonist activity, neural contribution as a benchmark of strength development pre-movement silence, motor unit recruitment, selective activation of muscle agonists in a group of muscles, and coordination of movement patterns and skills.

Biomechanical characteristics and motion analysis in a boxer cannot be separated from the joint as a fulcrum, muscle as an effort, bone as a structure or moving tissue, capsuloligament as a component that strengthens and stabilizes joints and other soft tissues around joints such nerves, blood vessels, exchanges, and skin. A pattern of motion that is good at forming a punch angle and punch range, requires good stability and joint mobility and is supported by an effective and efficient muscle pulling angle that results in a strong and on target hit.

A boxer in straight, uppercut, and hook, must pay attention to the pulling angle of the arm mobilizer muscles, especially the triceps brachii muscle, biceps brachii, and the pectoralis major muscle when contracting eccentrically and concentrically. Besides that, an equally important factor is the activation of the stabilizing muscles for the stabilization of the

proximal joint, as well as the magnitude of the angle at which to punch. The tensile angle of the muscle is the angle formed by the longitudinal lines of muscle and axis pulling. Mechanical strength / muscle pull is more efficient at a 90-degree angle in a lever system. Muscle strength will decrease if the pulling angle of the muscle is smaller than 90-degrees because some of the strength is used first to close the two joint surfaces before a movement occurs, but if the pulling angle of the muscle is greater than 90 degrees, the joint becomes less stable. Likewise, the corner should combine footsteps with a trunk rotation when making a punch. Straight, uppercut, and hook blows are punches aimed at knocking out an opponent if done with full force and the right muscle explosive power and the correct technique including the angle of the punch. Therefore, the strength of the upper and lower arms and legs must be thoroughly trained because it has proven to be the key to success¹⁸.

Endurance

Musculoskeletal endurance and cardiorespiratory endurance. Muscle endurance is the ability of the muscles to determine a long time, while the endurance of the heart and lungs is the ability of the heart and lungs to meet aerobic energy needs for a long time. The combination of strength and endurance produces muscle endurance,

namely the ability to do a lot of repetition of the defense / load given for a long time^{7,15}. The average is 1% per year over the age of 30 years. Decreases occur due to several factors, including cardiac output (cardiac output) decreases and respiratory function changes. Decrease in cardiac output occurs due to the lack of strong contraction of the heart muscle caused by a decrease in heart muscle mass. While a decrease in respiratory function is caused by reduced vital capacity and muscle oxidation capacity. The respiratory system provides oxygen to the body. The distribution of oxygen throughout the body is a function of the heart. In people who experience an increase, their lungs will increase, both the increase in oxygen from outside the body changes to oxygen¹².

Boxing is a popular martial arts sport that is intermittent by relying on aerobic and anaerobic energy transfer systems¹⁸. A boxer needs endurance (stamina), which is prime in training and competing in the ring. Professional boxing matches that last for 12 rounds in which each three-minute round with rest time every two minutes' rounds of course drains not a lot of energy, therefore the intake of nutrients with good nutrition is needed for physical performance, especially for musculoskeletal endurance and cardio respiration⁴. The official journal of the American College of Sports

Medicine, suggests that the energy requirements for boxing exercise vary greatly such as when hitting punching bag, calories burned by 354-558 calories per hour, sparring 531-838 calories per hour, and when competing in the 708 boxing -1.117 calories per hour¹⁹. The amount, composition and timing of food intake greatly influences sports performance and athlete performance⁴.

Speed

The ability to move quickly is an integral component of success in various sports⁷. Speed is the ability to make consecutive movements in the shortest possible time. The combination of endurance and speed is called speed-endurance^{7,15}. Boxing sports branches require speed, in addition to other components, namely, muscle strength, endurance, explosive power, agility, flexibility, balance and coordination.

Reaction time in boxing is needed for speed of motion or action to hit either the stimulus starts or without stimulus. Reaction time is used when an opponent is open defense or there is a gap to attack so that a quick response to attack is needed in boxing, whether in a state of attack or avoidance²⁰. Boxing sports prioritize muscle strength and speed of thinking when hitting. If it takes too long to make a decision, the boxer will lose momentum in

attacking and even backfire for him. Boxers must own reflex motion or automation. Boxers must understand every stimulus that comes later without thinking long must be able to decide what to do. Without thinking, he made the right footsteps, avoided the opponent's punch, and without thinking he also carried out an attack that was able to finish off the opponent. Boxing sport is an intermittent sport characterized by short duration with high intensity, which is a combination of anaerobic and aerobic activities with a ratio of 70-80% and 20-30%, so this sport really needs speed and strength²¹.

Degeneration process

By paying attention to aspects of physical fitness and nutritional intake for a boxer it is not enough if it does not take into account the age factor and the degeneration process that occurs. The degeneration process is a natural process that occurs in each individual, characterized by the disappearance of the ability of cells and tissues to repair and replace themselves and maintain normal structure and function. In the process of aging / degeneration anatomical changes will occur from the organs of the body over time²².

Likewise, the musculoskeletal, neuromuscular, cardiorespiratory systems, digestive system, hormonal system, reflex system, and other body systems will decrease function⁸. The

degeneration process starts from the cellular level to the function of the limbs and the body as a whole.

Cell degeneration or cell deterioration is a cell abnormality that occurs due to injury. Minor injuries that affect the structure in cells such as mitochondria and cytoplasm will interfere with the cell's metabolic process. This damage is reversible which means it can be repaired if the cause is immediately removed. If it is not removed, or gets heavy, the damage becomes irreversible, and the cell will die (necrosis).

Necrosis is a cell death as a result of acute cell damage or trauma (for example: lack of oxygen, extreme temperature changes, and mechanical injury), where cell death occurs uncontrollably, which can cause cell damage, an inflammatory response and potentially cause serious health problems. Stimulus that is too heavy and lasts longer and exceeds the cell's adaptive capacity will cause cell death where the cell is no longer able to compensate for the demands of change. A group of cells that experience death can be identified by the presence of lysis enzymes that dissolve various cell elements and the onset of inflammation.

Leukocytes will help digest dead cells and morphologically changes begin to occur. Necrosis is usually caused by a pathological stimulus. In addition to pathological stimuli, cell

death can also occur through the mechanism of programmed cell death where after reaching a certain lifetime, the cell will die. This mechanism is called apoptosis, the cell will destroy itself (suicide / suicide), and apoptosis can also be triggered by a state of ischemia²³.

Injuries and collisions always occur in boxing sports which can cause damage / death of cells and tissues, including brain cells, even to the point of taking lives. Whether we agree or disagree with boxing as a sport, it remains a popular fighting sport throughout the world. The security of boxers, both in the short and long term, creates strong opinions on both sides of the debate and calls for the sport to continue.

Published systematic reviews have carefully reviewed the scientific evidence for the health effects of boxing and did not find strong evidence for the relationship between amateur boxing and chronic traumatic brain injury while the small but significant proportion of professional boxers seems to experience this problem, for example a heavyweight boxer Mohammad Ali, suffered chronic trauma to the head and brain which resulted in him suffering from Parkinson's. Exposure to high injuries experienced by boxers (as a result of sufficient training time) shows that boxing has a level of acute injury that is comparable and often lower than that found in contact sports and other

non-contacts. Furthermore, acute injuries during training appear to be less common and severe than those suffered in combat²⁴.

Amateur boxing is different from professional boxing for different reasons, including different motivations for competition, rules, and equipment, but the most important is related to greater opposition to professional boxers (longer battles, more boxing experience, smaller and lighter boxing gloves, bigger score prizes for blows that hurt opponents, longer careers after amateur careers). A knockout is a rare occurrence in amateur boxing for example, the 2001 world amateur championship was only 6 knockouts out of a total of 366 battles. Highlighting these differences, there is a studio that shows one hit from a professional heavyweight-boxing champion that can provide impact strength of up to 6320 N (0.63 tons). Instead, a comparable blow will be given by a wooden hammer placed with a mass of 6 kg (13 lbs) if swung to the target²³.

This sport is a high-intensity sport that requires qualified physical characteristics as a condition for achieving success in every performance¹. However, the degeneration process starts from the age of 30 years where there is a decrease in the function of all body systems by 1% every year. On the other hand, the golden age of a boxer lasts between 10-15 years. Therefore, in the golden age, a boxer must be used optimally

in his class, both at the national, regional and international levels.

Anxiety

Tangkudung and Mylsidayu stated that, anxiety is one of the mental symptoms that is identical to negative feelings¹¹. Based on its type, anxiety is divided into two types, namely state anxiety and trait anxiety. State anxiety is an emotional state that occurs suddenly or at a certain time that is characterized by anxiety, fear, tension, and usually this anxiety occurs before the match. The other anxieties that occur to athletes are usually afraid of failing in the competition, fear of social consequences for the quality of their achievements fear of injury or other things that happen to him, fear of physical aggression by both the opponent and himself, and fear that his physical condition will not be able to complete his task or match properly.

Martens's next opinion in Vuong Ngo, stated anxiety is related to acute fear of failure and negative thoughts, which can lead to loss of self-confidence and concentration²⁵. On the other hand, trait anxiety is anxiety which is a personal / innate trait. According to Gunarsa, the nature of anxiety is a predisposition to perceive environmental situations that threaten him²⁶. An athlete basically has the nature of anxiety, so the manifestai of anxiety will always overdo and dominate the

psychological aspects¹⁰. This is a serious obstacle for the athlete to be able to perform well¹¹.

Komaruddin, stated that people who agree to high levels without being accompanied, confidence will experience an increase in performance decline²⁷. Furthermore, according to Harsono one of the factors that can affect the athlete's peak performance is that which is related to the athlete's condition, namely anxiety (anxiety), fear of injury, fear of wrongdoing, fear of losing, etc²⁸. Tension issued by athletes that exceed normal limits or stress thresholds, athletes will overcome anxiety.

In general, athletes discuss the facts conveyed by the participants. Indicators that can be taken from an altered athlete can be seen from physical or psychological changes. Another study by Bebetosos stated that, reason is one of many that can emerge as an athlete's reaction in competitive competition²⁹. Similarly, Verardi discusses emotions that are triggered by stress from internal and external conditions³⁰.

As a result of this psychosomatic disorder, a boxer will experience stress (over training) which is characterized by a pulse, the amount of breathing, and increased body temperature, decreased body weight, pain, increased stomach acid, weakness, changes in behavior

and decreased enthusiasm so that finally no concentration and not focus on fighting. There are several ways to overcome anxiety, namely by relaxation through stretching the muscles (stretching) and listening to music, visualizing by showing (watching the best videos), and self-motivating optimistically¹¹.

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CONCLUSION

From the existing theories and discussions which have been stated, it can be concluded that paying attention to the bio motoric aspects of a boxer is not enough if the age factor and the degeneration process that occurs are not taken into account. The degeneration process is a natural process that starts from the age of 30 where there is a decrease in the function of all body systems by 1% per year.

A balance between physical can slow the degeneration process, psychological, and environmental factors including the life style of a boxer. On the other hand, the golden age of a boxer lasts between 10-15 years. Thus, the factors of strength, endurance, speed, and

psychological factors in the form of anxiety influence each other, both directly and indirectly against peak performance in the achievement of a boxer.

Therefore, to practicing routinely in boxing, periodic measurements and evaluations of bio motoric components and mental training have to be considered, so that during the golden age, boxers can achieve optimally.

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