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Trauma Determinants Affecting Health and Well-Being: Exercise Double-Edge

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ABSTRACT

Head and body trauma describe any and all injuries that result in trauma to the structure, function and integrity of individuals by covering broad, wide-ranging and of great variation in severity and locus of injuries, due to a myriad of different causes, that include accidents, falls, physical assault, sports, training, exercise or traffic accidents, that may induce head injuries as the more serious outcomes. Despite the multiple benefits of sports and exercise participation for children's, adolescents', young and older adults biopsychological, physical, social and health-inducing propensity, the emergence of apparently incremental health and economic issues renders a situation fraught with concern. For example, among the currently prevalent chronic lower body-extremity loci of trauma-injury that are displayed in sports medicine and physical exercise training and performance perceived from on-going investigations the actualization and manifestations of preventative measures to both the understanding and preparation of would-be sportspersons and athletes requires greater attention. In de facto situations, such as ischemia-reperfusion insults, as the outcome from the temporary restriction of blood flow causes tissue/organ damages under various disease conditions, including stroke, myocardial infarction, trauma and orthopedic surgery; lead to the tissue damage incurred when the blood supply returns to particular tissue following a period of ischemia or lack of oxygen, i.e. anoxia or hypoxia. Finally, further investigation concentrating upon the 'hormesic' qualities of physical exercise program for disorder resistance/prevention ought to be assigned greater focus and attention.

Keywords: Trauma, Injury, Exercise, Brain, Body, Prevention, Intervention

Endurance and resistance exercise training programs/schedules have been described repeated to promote tissue resilience and resistance to numerous pathological insults [1]. Childhood adversity, neglect, abuse and malnutrition all debilitate individuals' resilience and capacity to maintain intact somatic and neurohealth thereby allowing for the encroachment of neuropsychiatric disorders, poor general health and functional enfeeblement [1,2]. The Affective Brain Syndrome in deaf psychiatric patients is expressed as emotional disturbances and 26% of the causes of deafness are related to known brain injuries including prematurity, meningitis, rubella and other infections [3]. It is emerging that experience of early life trauma demands much greater consideration as an antecedent to both childhood traumatic brain injury and insult which may explain, at least partially, some of the previously-observed association of mild traumatic brain injury with subsequent offending behavior [4]. Nonetheless, sports and exercise, at adolescent or young adult ages, may induce also a myriad of destructive pressures and injuries if indulged in without proper planning and consideration. Under conditions of disadvantage/unrestricted effort, exertional limb pain may emerge as a recurrent, chronic problem encountered in recreational and competitive athletes. The vascular causes of exercise-related lower limb extremity pain, in the context of the respective epidemiology, common signs and symptoms, encompass arterial endofibrosis, popliteal artery entrapment syndrome and chronic exertional compartment syndrome of both the upper and lower extremities [5]. In this context, the determination of types and incidence of running-related lower extremity injuries and identification of socio-demographic and motivational risk factors among novice runners attending an eight-month running school may be indicative. Over a three year period, 349 novice runners

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were examined for socio-demographic, anthropometric, and data on running motivation and self-perceived health and fitness components of "risk-exercise" [6]. There were 173 injuries recorded, less frequently among women (42.9%) than among male participants (62.7%). Median self-perceived fitness level, on a ten-point visual analog scale, was 4 points at baseline and 8 at post-school estimation. Median self-perceived overall health was 6 at baseline and 8 at post-school estimation The knee had a significantly higher rate of injuries compared to other anatomic regions with participants presenting improvement of fitness as the most common motivation for entering the school. Thus, it may be concluded that these novice runners ought to by necessity include strengthening exercises for knee injury prevention into their training routines. Unfortunately, the current usage, understanding and awareness of lower limb extremity injury prevention programs remains circumscribed by a paucity of research enterprise, communication and education between exercise investigations, practitioners, sporting associations and coaches and curtailed by perceived time constraints [7]. In general, these Injuries have been defined by body region, i.e., head, eye, neck, shoulders, thorax, forearm, hand, abdomen, hip or thigh, knee, lower-leg and ankle or foot) and type of injury, superficial, open wound, fractures, dislocations, muscle or joints, dental, nerve or spinal cord, traumatic brain injury, ocular, internal organ, foreign body and drowning.

Among the most prevalent chronic lower body extremities injuries displayed in sports medicine, ongoing investigations lend credence to applications of destabilization training and pressure medialization tactics for Chronic Ankle Instability, foot strike/loading and cadence interventions for Exercise-Related Lower Leg Pain and Patellofemoral Pain and limb off-loading techniques for Anterior Cruciate Ligament with Reconstruction with the involvement of commonly-used devices such as accelerometers, custom gait-training footwear, metronomes and pressure sensors [8]. Nevertheless, although there exist certain commonalities among these gait-training interventions, wearable sensors, for chronic pathologies, of necessity a development of greater standardized approaches and clinical predictor rules should facilitate the identification of the most appropriate interventions. As a related issue, individuals presenting spinal cord injuries more-often-then-not experience general weakness in the lower body extremities which are accompanied by outcomes expressed through the undermining of daily step activity. In a study wherein participants (patients) presented long-standing spinal cord injuries who were capable of completing a 10 m walk assessment were assigned to a task involving a two-times per week for 12 weeks through applications of a lower body eccentric resistance training machine and estimating eccentric strength, isometric strength, and daily step physical activity [9]. It was observed that eccentric strength and isometric strength were improved by the exercise training intervention whereas the daily step activity measure remained largely unchanged. Eccentric resistance, i.e., the motion of an active muscle while it is lengthening under load and eccentric training which is repetitively doing eccentric muscle contractions, exercise improved eccentric and isometric, done in static positions, strength, in which the joint angle and muscle length do not change during contraction, by comparison to concentric or eccentric contractions, called dynamic/isotonic movements, through the mobilization of physiological adaptations may translate to improved gait mechanics [10].

It has been shown that Ischemia-reperfusion insult resulting from the temporary restriction of blood flow causes tissue/organ damages under various disease conditions, including stroke, myocardial infarction, trauma and orthopedic surgery; is the tissue damage incurred when the blood supply returns to particular tissue following a period of ischemia or lack of oxygen, i.e., anoxia or hypoxia, Thus, the absence of oxygen together with necessary nutrients from the blood during the ischemic period creates a condition in which the restoration of circulation results in pro-inflammation conditions and oxidative damage to tissues through the induction of oxidative stress and reactive oxygen species rather than, or accompanied by, the restoration of normal functioning. Traumatic injury, despite the high regenerative capacity of skeletal muscle, may permanently impair muscle regeneration. In the lower limbs, Ischemia-reperfusion injury to motor nerves and muscle fibres induces reduced mobility and quality of life. Among sedentary and exercise-trained mice involving five weeks of voluntary treadmill running, that were subjected to ischemia by unilateral application of a rubber band tourniquet above the femur for 1 hour followed by reperfusion induced a significant level of muscle injury and denervation at the neuromuscular junction already by 3 h after tourniquet release in addition to depressed muscle strength and neuromuscular transmission among the sedentary mice [11]. Among the exercise-trained mice there were marked reductions of muscle injury and denervation at neuromuscular junction with improved regeneration and functional recovery following Ischemia-reperfusion, despite similar extents of muscle atrophy and oxidative stress as among the sedentary mice. In combination, this evidence imply that the endurance exercise schedule preserved motor nerve and myofiber structure and function from Ischemia-reperfusion injury and promote functional regeneration. Male Wistar rats were assigned to control, sham, control + Ischemia-reperfusion and training+Ischemia-reperfusion groups. The Ischemia-reperfusion groups were anesthetized and underwent a left thoracotomy to access the left anterior

descending coronary artery, which was occluded by a silk suture for 30 min and released for 90 min of reperfusion and gene expression of mitofusin 1, mitofusin 2 and dynamin-related protein 1 were estimated [12]. Their results indicated that Cardiac infarct size was markedly lesser in the exercise +Ischemia-reperfusion group than in control+Ischemia-reperfusion with the former expressing higher proportions of mitofusin 1 and mitofusin 2 whereas conversely, dynamin-related protein 1 expression was lower after exercise training. Interventions using engineered biomimetic scaffolds to the site of muscle ablation in combination with voluntary exercise have been used to treat muscle trauma. In this context, it has been shown that the voluntary exercise-scaffold amalgamation improved the regenerative effect of aligned scaffolds by augmenting neurovascularization (abundance of neuromuscular junctions was 19-fold higher), thereby introducing important implications in the design of engineered biomimetic scaffolds for treatment of traumatic muscle injury [13].

Over the advancing lifespan, interlimb coordination, posture and gait performance diminish with age, thereby posing a risk for gait-related injuries while levels of inhibition within the motor cortex are associated markedly with coordination of the upper extremities in healthy aging, yet whether or not same association exists for lower extremity control remains to be elucidated. In a study of young and older adults, Gait coordination was reduced in older adults while walking at their self-selected pace, as was cortical inhibition, solely in the non-dominant motor cortex; additionally, the young adults demonstrated higher levels of maintenance of lower extremity coordination and variability with reductions in cortical inhibition while on the other hand, the older adults associated with increased cortical inhibition demonstrated a higher level of walking performance [14]. Taking into account the situation that gait impaired patients presenting dementia, a strongly established risk factor for falls among the aged elderly, fall twice as often and have more serious fall-related injuries than healthy older adults, the conditions implies an immediate concern for trauma. In a systematic review it was shown that elevated double-support time-variability, use of mobility aids, outdoor-walking, higher scores on the Unified Parkinson's Disease Rating Scale, and lower average walking bouts were associated with elevated risk of any type of fall [15]. Increased double support time and step length variability were associated with recurrent falls; the variability property of gait has been quantified using both temporal and spatial gait characteristics whereby the variability of temporal characteristics, such as stride time, double support time and stance time and spatial characteristics such has stride length has been consistently associated with falling, with increased variability being associated with fall risk thereby supporting the contention that among dementia patients specific spatiotemporal gait parameters and features that are associated with falls. In an analysis of post-traumatic stress severity, it was observed that taking into comparisons of acute, less than one month since trauma, “acute” and sub-acute more than one month, “sub-acute” post-traumatic stress symptom severity that white matter microstructure for acute level trauma of the uncinate fasciculus and fornix/stria terminalis varied with acute post-traumatic stress severity [16]. In this regard, acute white matter microstructure of the cingulum bundle and fornix/stria terminalis varied with sub-acute post-traumatic stress severity therewith implying that the ongoing status of white matter architecture of the prefrontal cortex - amygdala network were implicitly involved in the development of trauma and stress-related disorders.

Exercise abuse/overuse, linked to enormous financial liabilities, claims also an enormity of costs in terms of suffering and short-/long-lasting affliction that hinders functionality: (i) overuse tendinopathy induces in the tendon pain and swelling with associated decreased tolerance to exercise and various types of tendon degeneration, (ii) juvenile osteochondritis dissecans, which is characterized by delamination and localized necrosis of the subchondral bone, with or without the involvement of articular cartilage, (iii) and poor/undifferentiating, maladaptive exercise techniques/programs especially among the elite and a variety of risk factors frequently predispose athletes to stress reactions that may be interpreted as possible precursors of stress fractures [17]. Taken together and across domains, exercise strength and conditioning training programs according to the lifetime Prevalence for injury are invariably commensurate over both technique and lifespan [18]. Furthermore and central to the notion of trauma, both fatal and severe nonfatal brain and spine injuries may occur during sporting activities “catastrophic” injuries have had to be confronted in contact sports such as football, rugby, boxing, wrestling and ice hockey, as well as in noncontact sports including baseball, cheerleading, swimming and diving, equestrian, gymnastics, pole vault, rodeo, snow skiing, snowboarding, and horse-racing [19]. Nevertheless, by taking into account the incidence the occurrence of fall-related injuries that are invariably ameliorated by physical exercise programs for both elderly and motor-incapacitated [20-22] exercise beneficial effects upon falls-propensity in patients with dementia habilitating within nursing homes, and whether effects were dependent on gender, dementia-type, ageing or need-for-improvement in balance. Among older people presenting dementia and abodding in nursing home environment, a high-intensity functional exercise program by itself failed to prevent falls when compared with an attention control group, although compared with a sedentary group,

exercised group were less likely to sustain moderate/serious fall-related injuries at 12 month follow-up [23]. Finally, single sessions of low-intensity physical exercise during the early, acute period, acute following traumatic brain injury promoted behavioral performance without inducing any cognitive deficits whereas the introduction high-intensity exercise were shown to exacerbate cognitive function in the early, acute period after traumatic brain injury implying that the optimal timing of rehabilitation and exercise intervention intensity ought to be considered crucial for behavioral and recovery of memory consideration in the event of traumatic brain injury [24,25].

CONCLUSION

Although it has been well-establish that physical exercise generally improves performance, health and well-being over an, as yet undetermined, range of disease states and ensures healthy conditions proactively, over-exaggerations of sports and exercises, over a wide variety of disciplines, often results in injury and trauma, not least within the lower limb extremities. Current discernment of the need for preventative measures will eventually emerge to capture much of the health focus that seems to be attached to interventional measures. Confronted by the increasing incidence of populations identified by ever advancing lifespans, interlimb coordination, posture and gait performance will continue diminish as the proportions of the aged to adult young and middle-aged becomes less balance, thereby posing a risk for gait-related, and other, injuries while levels of inhibition within the motor cortex are associated markedly with coordination of the upper extremities in healthy aging, yet whether or not same association exists for lower extremity control remains to be elucidated. In this context, ischemia-reperfusion insults, as the outcome from the temporary restriction of blood flow causes tissue/organ damages under various disease conditions, including stroke, myocardial infarction, trauma and orthopedic surgery; lead to the tissue damage incurred when the blood supply returns to particular tissue following a period of ischemia or lack of oxygen, i.e., anoxia or hypoxia. Among athletes, vessel wall injury/trauma observed through examinations athletic samples has often been related to repetitive and persistent, serious microtrauma to the venous and arterial walls arising as the direct outcome of sport-/excessive exercise-dependent muscle trauma, in combination with to higher levels of metabolic rates and repetitive blood monitoring. Adaptation and conditioning, as compatible and interchangeable notions, imply that low levels of incremental exercise stress have been observed to mobilize and up-regulate molecular and cellular pathways to promote cells and organs to enhancements of physiologic resilience to injury and trauma.

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