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Adapted physical activity: Benefit on oxidative, functional capacity and exercise tolerance of elderly people in Kinshasa

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Abstract

In basketball, shooting stands out as a vital technique directly affecting the game results. Identifying shooting mechanics early in a basketball player's career can significantly develop shooting performance in subsequent years. This study aimed to explore shooting percentages based on angular positions of joint parts in the shooting techniques of youth basketball players. Fifteen male participants (average age: 14.1±0.7 years, height: 180.7±7.9 cm, body weight: 65.4±10.0 kg, sports experience: 4.7±0.4 years) voluntarily participated in the study. They were divided into high shooting rate (n: 7) and low shooting rate (n: 8) groups. Both groups attempted 60 shots from the free throw line (20 shots), right forward position (20 shots), and left forward position (20 shots). Joint angle values during the initial and final shooting phases were compared between groups using Independent t-tests. Significant differences were found between groups in the shoulder part during the beginning phase and the wrist part during the final shooting phase ($p<0.05$). These findings underscore the potential for targeted enhancement of shooting mechanics among young basketball players through posture analysis (joint angle parts) using both performance assessments and electronic software tools.

Introduction

The elderly population is defined by an age greater than or equal to 65 years. This population represented 19.1% of the total population in 2016, 20.4% in 2020 and will represent 25.7% in 2040 according to the World Health Organization (WHO, 2015). According to studies, a third of elderly people live at home and fall at least once a year, which represents 450,000 falls each year regardless of their age. Falls constitute the leading cause of death by accident in everyday life (Chassagne et al., 2009), this frequent and often underestimated event, which represents a common mode of entry into dependence and is associated with an increase in hospitalizations, surgical procedures, malnutrition, pain, cognitive disorders, walking and balance disorders, sedentary lifestyle and health costs (Fried et al., 1991; Fortin et al., 2009). The care of the elderly falls primarily under outpatient medicine, and therefore relies largely on general practitioners. One of the keystones of general medicine is prevention, allowing a person to avoid health events which will affect their reserve capacities and harm their autonomy as well as their quality of life (Rolland et al., 2011 Rockwood et al., 2005). Elderly people who practice regular physical activity, who have appropriate nutritional intake and who live in a suitable environment can age ideally while preserving their autonomy and quality of life. Despite the benefits clearly demonstrated in the various international programs to promote physical activities, few studies exist on geriatrics and adapted physical activity in subaerial Africa. Furthermore, the majority of African elderly people remain at home only in old people's homes, structures which are supposed to contribute to improving the consequences of a sedentary lifestyle imposed by the advancement in age of over 65 years. In the Democratic Republic of Congo (DRC) in general and in Kinshasa in particular, no

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study has developed a Physical Activity program adapted to people over 65 years old in the country and has not researched the effect of said program on postural control, functional capacity, maximum oxygen consumption and exercise tolerance in elderly people followed at old people's hospices in Kinshasa. It is to fill this gap that the present study is undertaken to investigate the effect of an Adapted physical activity program on maximum oxygen consumption, exercise tolerance and functional capacity elderly people followed at old people's hospices.

Methods

Type, sample and study program

In a quasi-experimental study carried out in the Lukunga district old people's hospices in the city province of Kinshasa. 41 people aged 65 and over were subjected to a 12-week Adapted Physical Activity program consisting of walking, mobilization, balance and moderate intensity stretching exercises of 35 minutes per session, 3 times per week combined with muscle strengthening exercises of 10 minutes per session, 5 series of 30 seconds of work and 10 seconds of rest, 3 repetitions per session with a progressive load according to the level of adaptation to the effort of each participant, two times a week.

Procedure

The walking and mobilization exercises consisted of flexion-extension, elevation, swinging, tilting, and circumduction movements depending on the degree of freedom of each joint of the upper and lower limbs for 20 minutes or 10 minutes walks with its variations, 10 minutes of mobilization exercises in a standing position. Static and dynamic balance exercises such as arms extended horizontally and the leg extended to the side, support, bending or flexing forward, to the side then in front of you; walk on tiptoes then on heels 3 to 5 times a week, 3 sets of 30 seconds, 5 repetitions per session in a standing, sitting and lying position. Muscle strengthening exercises such as standing up with your arms stretched horizontally and to the side, bending your forearms to 90° then straightening them with a light load and sitting down from a chair, climbing stairs, performing housework, washing movement and strengthening the lower limbs on the ground, 2 times a week, 5 sets of 30 seconds of work and 10 seconds of rest, 3 repetitions per session in a standing, sitting and lying position with a progressive load. Static stretching exercises for the upper limbs, trunk and lower limbs, 3 to 5 times per week, 3 sets of 30 seconds, 5 repetitions per session.

Parameters, Tests and Measurements

Static balance

The single-leg balance test consists of asking the subject to hold a single-leg position for as long as possible, on the lower limb of their choice. It is considered abnormal if the elderly person cannot hold on one leg for at least 5 seconds: a time of less than 5 seconds is predictive of a very high risk of falling; a time of more than 30 seconds is predictive of a very low risk of falling. The sensitivity is 37%, the specificity is 76% (Riebe et al., 2018).

Functional capacity and dynamic balance

The functional capacity and dynamic balance of the elderly were measured by the Timed Up and Go test which consists of placing the elderly person in a sitting position on a chair, leaning against the backrest, their feet resting flat on the ground and getting up from the chair. chair, travel 3 meters forward, go around the marker on the ground to turn around and then return to sit on the chair to return to the starting position. A Timed Up and Go test value greater than 13.5 seconds reflects poor functional capacity and a dynamic balance disorder (Izquierdo et al., 2016; Beauchet et al., 2011; Fournier et al., 2012).

Lower limb muscle strength and function

The strength and muscular function of the lower limbs were assessed by Sit-Stand Test where the elderly person is seated on the front part of the chair, not leaning against the backrest, back straight, feet flat on the ground and arms crossed on chest or hands on opposite shoulders and performs the greatest number of lifts in 30 seconds. The number of chair raises performed in 30 seconds less than 14 causes muscle weakness and loss of function of the lower limb muscles (4). The 6 min walk test (TDM6) which consists of covering a greater distance in minutes of walking around 2 blocks separated by 30 meters (Riebe et al., 2018; Holland et al., 2014).

Maximum oxygen consumption (VO_2 max) and exercise tolerance

The maximum oxygen consumption (VO_2 max) was measured by the indirect method of (Reychler, 2014) expressed by the following equation: VO^2 max (ml/Kg/min) = 0.024 x Distance from TDM6 (m) – 0.06x weight (Kg) + 0.06 x age + 6.44. The parameters analyzed before and after the test are the total distance covered in 6 minutes and the evolution of heart rate using a heart rate monitor, a pulse oximeter. Exercise tolerance was assessed by profuse sweating, shortness of breath and fatigue at least effort. The reserve Heart Rate measured by the formula of Heyward et al. (2010), FCR = HR max - Resting HR including HR max in beats per minute (bpm) was evaluated using the formula Tanaka et al. (2008): HR max= 208- (0.7x age). Total body fat in %, visceral fat in % and muscle mass in % by the Omron BF-511 Healthcare Netherlands brand inpedance meter scale / the Netherlands (Reychler et al., 2014; Kusuayi et al.,2018).

Statistical Analysis

The collected data were entered and processed using SPSS 21.0 software. The normally distributed quantitative variables were expressed as means ± standard deviation. Comparison of the means of continuous variables before and after the program was carried out using the paired Student's t test. A p value ≤ 0.05 was considered as the threshold for statistical significance.

Results

Comparison of exercise tolerance, maximum oxygen consumption and functional capacity parameters in the elderly is presented in Table 1.

A significant increase in exercise tolerance, aerobic, cardiovascular, functional capacity and postural control after the adapted physical activity program respectively: +38 minutes (12 vs 50); $p < 0.001$ for severe fatigue, +34 minutes (11 vs 45); $p < 0.001$ for choking on exercise, +45 minutes (10 vs 55); $p < 0.001$ for profuse sweating; +136 meters (243 vs 379); $p < 0.001$ for the distance traveled in 6 minutes, +4 ml/kg/min (12 vs 16); $p < 0.004$ for VO_2 max , +8 Bpm (71 vs 80); $p < 0.001$ for heart rate reserve, +13.8 seconds (13.1 vs 27); $p < 0.001$ for the muscular strength of the Lower Limbs and + 16% (19 vs 35) ; $p < 0.003$ for muscle mass. On the other hand, a reduction in resting heart rate and the duration of static and dynamic balance achieved was observed after the program: - 9 Bpm (89 vs 80); $p < 0.001$ for resting heart rate, - 6.6 seconds (16 vs 9.4); $p < 0.002$ for dynamic balance and - 11 seconds for static balance (20.14 vs 9.3); $p < 0.001$.

Table 1

Comparison of exercise tolerance parameters, maximum oxygen consumption, functional capacity and postural control of elderly people before and after the adapted physical activity program.

Variables	Before	After	t	p
Age (years)	69±15.60	69±15.60		
Male, n (%)	19(46.3)	19(46.3)		
Female, n (%)	22(53.7)	22(53.7)		
Body Composition				
Total Body Fat (%)	39±8.12	29±8.85	1.27	0.001*
Visceral fat (%)	10±2.43	8±2.66	0.91	0.004*
Muscular mass (%)	19±3.85	35±2.99	0.54	0.003*
Exercise tolerance				
Severe fatigue (min)	12±4.23	50±3.55	1.82	0.001*
Shortness of breath on exertion (min)	11±2.11	45±1.67	1.98	0.001*
Profuse sweating (min)	10±4.10	55±4.99	0.78	0.003*
Aerobic and cardiovascular capacity				
TDM6, Distance (m)	243±21.70	379±19.56	0.98	0.001*
VO_2max (ml/kg/min)	12±25.24	16±1.66	1.86	0.004*
Resting Heart Rate (bpm)	89±10.98	80±9.51	1.82	0.001*
Maximum Heart Rate (bpm)	160±15.56	160±15.56	1.78	0.087
Reserve Heart Rate (bpm)	71 ±10.50	80±10.20	2.24	0.001*
Functional capacity				
Dynamic balance (dry)	16.07±5.10	9.4±7.11	0.86	0.002*
Static equilibrium (dry)	20.14±8.94	9.3±9.20	1.32	0.001*
Muscle strength of the lower limbs (dry)	13.1±7.12	27±9.72	1.65	0.001*

** p<0.01*

Discussion

A significant improvement in exercise tolerance, maximum oxygen consumption, functional capacity and postural control, strength and muscle mass of elderly people subjected to the adapted physical activity program was revealed. These results are similar to the results of Penzer (2015) who showed that 6 weeks of training based on muscle strengthening and balance exercises improves functional capacity and postural control in elderly people (Penzer et al., 2015). Studies have also shown that older people regularly practicing one or more physical activities revealed better performance than their inactive counterparts in measures of postural control and functional capacity (Kozma et al., 1991; Rikli et al., 1986; Wong et al., 2001). These results are confirmed by Rikli (1991) who showed that a 3-year physical activity program significantly improved functional capacity and postural control as well as muscular strength in elderly people (Rikli et al., 1991). Indeed, studies carried out over the last twenty years on the effects of physical exercise in the elderly show that regularity in a physical activity program brings multiple benefits throughout life and is a necessary condition for successful aging (Ferrucci et al., 1999). The improvement in maximum oxygen consumption generates a reduction in reaction time and an increase in force and contraction speed can thus make it possible to increase the spontaneous activity of elderly subjects, even very elderly and fragile subjects (Blain et al., 2000). During aging, endurance or muscle strengthening activities are the source of many favorable physiological responses. Regular and appropriate physical activity contributes to reducing, or preventing certain deleterious processes linked to advancing age, to improving the quality of life of elderly subjects and to delaying the onset of dependence by maintaining their autonomy (Blain et al., 2000).

Conclusion

A regular, reasoned and reasonable adapted physical activity program increases oxidative capacity, exercise tolerance, postural control, heart rate reserve, muscular strength, functional capacity and contributes to improving elderly people's motor performance. In view of the results obtained, developing and promoting this Adapted Physical Activity program developed for its application in all the hopes of elderly people in the Democratic Republic of Congo would be beneficial because it allows the latter's body to adapt to the characteristics specific to its environment.

Author's Contribution

Study design: GK, Data collection: SNT, SB, Statical Analysis: GK, CKE, Manuscript preparation: GK, CKE, Fund collection: CBN, DKM.

Ethical Approval

The study protocol was approved by the Medical Ethics Committee of the Ministry of Public Health of the Democratic Republic of the Congo (n*014 (CNES/BN/PMMF/2023; 23 November 2023) and was conducted in accordance with the Declaration of Helsinki.

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Conflict of Interest

The authors hereby declare that there was no conflict of interest in conducting this research.

References

Beauchet, O., Fantino, B., Allali, G., Muir, S. W., Montero-Odasso, M., & Annweiler, C. (2011). Timed up and go test and risk of falls in older adults: A systematic review. *J Nutr Health Aging*, 15, 933-938.

Blain, H., Vuillemin, A., Blain, A., Jeandel, C. (2000). The preventive effects of physical activity in the elderly. *Presse Médicale*, 29(22), 1240-1248.

Chassagne, P., Rolland, Y., Vellas, B. J. (2009). *La personne âgée fragile*. Springer.

Ferrucci, L., Izmirlian, G., Leveille, S., Phillips, C. L., Corti, M. C., Brock, D. B., Guralnik, J. M. (1999). Smoking, physical activity, and active life expectancy. *Am J Epidemiol*, 149(7), 645-653.

Fortin, M. P., Krolak-Salmon, P., & Bonnefoy, M. (2009). *Analyse descriptive et comparative des différents modèles de fragilité*. In : La personne âgée fragile. Springer.

Fournier, j., Vuillemin, A., & Le Cren, F. (2012). Mesure de la condition physique chez les personnes âgées. Évaluation de la condition physique des seniors : Adaptation française de la batterie américaine « Senior Fitness Test ». *Science & Sports*, 27(4), 254-259.

Fried, L. P., Storer, D. J., King, D. E., Lodder, F. (1991). Diagnosis of illness presentation in the elderly. *J Am Geriatr Soc*, 39(2), 117-123.

Heyward, V. (2010). *Advanced fitness assessment and exercise prescription* (Six th Edition ed.). US: Human Kjnetics.

Holland, A. E., Spruit, M. A., Troosters, T., Puhan, M. A., Pepin, V., Saey, D., …. Singh, S. J. (2914). An official European Respiratory Society/American Thoracic Society technical standard: Field walking tests in chronic respiratory disease. *Eur Respir J*, 44(6), 1428-1446.

Izquierdo, M., Casas-Herrero, A., Zambom, F. F., Martínez-Velilla, N., & Alonso-Bouzón, C. (2016). Guide pratique pour la prescription d'un programme d'activités physiques pour la prévention de la fragilité et des chutes chez les sujets âgés de plus de 70 ans. Available from:

https://www.chu-toulouse.fr/IMG/pdf/vivifrail-fr-web.pdf. (In French)

Kozma, A., Stones, M., Hannah, T. (1991). Age, activity, and physical performance: An evaluation of performance models. *Psychol Aging*, 6(1), 43-49.

Mabele, K., Ekisawa, N., Delecluse, C. (2018). Improvement of the cardiopulmonary capacity of patients with chronic obstructive pulmonary disease of Kinshasa by training of aerobic endurance and resistance. *Turk J Kinesiol*, 4(4), 149-154.

Penzer, F., Duchateau, J., & Baudry, S. (2015). Effects of short-term training combining strength and balance exercises on maximal strength and upright standing steadiness in elderly adults. *Exp Gerontol*, 61, 38-46.

Reychler, G., Roeseler, J., & Delguste, P. (2014). *Kinésithérapie respiratoire*. Elsevier Masson, 356-424.

Riebe, D., Ehrman, J. K., Liguori, G., & Magal, M. (2018). *ACSM's Guidelines for exercise testing and prescription*. Philadelphia (PA): Wolters Kluwer. American College of Sport Medicine.

Rikli, R., & Busch, S. (1986). Motor performance of women as a function of age and physical activity level. *J Gerontol*, 41(5), 645-649.

Rikli, R., & Edwards, D. (1991). Effects of a three-year exercise program on motor function and cognitive processing speed in older women. *Res Q Exercise Sport*, 62(1), 61-67.

Rockwood, K., Song, X., MacKnight, C., Bergman, H., Hogan, D. B., McDowell, I., & Mitnitski, A. (2005). A global clinical measure of fitness and frailty in elderly people. *CMAJ*, 173(5), 489-495.

Rolland, Y., Benetos, A., Gentric, A., Ankri, J., Blanchard, F., Bonnefoy, M., … Berrut G. (2011). Frailty in older population: a brief position paper from the French society of geriatrics and gerontology. *Geriatr Psychol Neuropsychiatr*, 9(4), 387-390. (In French)

Tanaka, H., Seals, D. R. (2008). Endurance exercise performance in masters athletes: Age-associated changes and underlying physiological mechanisms. *J Physiol*, 586, 55-63.

WHO (2015). *Rapport mondial sur le vieillissement et la santé*. Available from: http://www.who.int/ageing/publications/world-report-2015/fr/

Wong, F., Girgrah, N., Graba, J., Allidina, Y., Liu, P., & Blendis, L. (2001). The cardiac response to exercise in cirrhosis. *Gut,* 49(2), 268-275.