CARDIOVASCULAR RESPONSES TO EXERCISE TESTS IN SUBJECTS WITH POLIOMYELITIS: A PILOT STUDY

KOLAPO HAMZAT TK, BSc, M.ED, MNSP[1]
[1]Department of Physiotherapy, University of Ibadan, Nigeria

ABSTRACT: *People with physical disabilities often experience difficulty in different activities of daily living. Emphasis is usually placed on their medical rehabilitation, and there is often little attempt on meeting the health care needs after they are discharged from rehabilitation facilities. Recognition of the health care needs is required to provide effective treatment and facilitate health promotion activities. Decreased muscle strength in the lower limbs in victims of poliomyelitis often result in difficulties in mobility. As part of a larger study to evaluate the impact of regular aerobic exercise on the quality of life of individuals with physical disabilities, this pilot study attempted to obtain information on some immediate responses to the nine-minute walk/run test among a group of people with physical disabilities due to poliomyelitis. Compared to an age-matched control group, there was a higher cardiovascular demand on individuals with poliomyelitis. The outcome was suggestive of a need to assist the subjects in conserving energy during ambulation by improving endurance. Thus individuals with poliomyelitis are likely to benefit from regular aerobic exercise.*

KEYWORDS: POLIOMYELITIS, HEALTH PROMOTION, PHYSICAL EXERCISE, DISABILITY.

INTRODUCTION

There has been significant emphasis in health care on primary prevention of disability rather than on prevention or reduction of secondary health problems in people with disabilities (Rimmer, 1999). There is therefore little information on health promoting activities for people with disabilities. The aims of health promoting programs for people with disabilities are to reduce secondary health problems like hypertension and pressure sores, to maintain functional independence, to provide an opportunity for leisure and enjoyment, and to enhance the overall quality of life by reducing environmental barriers to good health. Physical exercise has been identified as a preventive health behaviour often employed as a strategy to improve health (Li and Yoshida 1998). Shephard (1991) highlighted some of the impact of physical activity on people with disability. The benefits included improvements in self-esteem, self-efficacy, perceived health, and ability to perform activities of daily living. A study was therefore initiated to evaluate the impact of regular aerobic exercise on the quality of life of individuals with physical disabilities. The current pilot study attempted to obtain information on some immediate responses to an exercise test in a group of people with physical disabilities due to poliomyelitis.

Poliomyelitis is an acute viral infectious disease caused by the neurophilic virus, known as poliovirus, that attacks the brain and the ventral horn cells of the spinal cord (Birk, 1993). The damage to the lower motor neurons of the spinal cord usually results in weakness, flaccid paralysis and atrophy of the muscle groups supplied by the affected segment of the spinal cord, with resultant deformity. The paralysis may affect the lower limb muscles only, lower limbs and lower trunk muscles (i.e. paraplegia), or both upper and lower limbs. In bulbar poliomyelitis, the poliovirus infects the medulla oblongata and may result in dysfunction of the swallowing mechanism along with circulatory and respiratory distress, apart from muscle paralysis of the extremities (Grimby and Jonsson, 1994).

The scientific and medical challenge posed by poliomyelitis at the beginning of the twentieth century was of a complexity similar to that of Acquired Immunized Deficiency Syndrome – AIDS (Wyatt, 1995). However, the advent of Salk and Sabin virus vaccines in 1954 and 1962 respectively, put a check on the effect of the debilitating virus. Adoption of a resolution in 1988 by the World Health Assembly to eradicate poliomyelitis globally by 2000, and efforts geared towards achievement of this goal, have resulted in various degrees of success in different countries (Klaucke et al, 1997; Okwo Bele et al, 1997). Prevention of paralytic infection by poliovirus has been shown to be remarkably effective using oral vaccination with live attenuated virus.

In spite of the vaccination however, poliomyelitis is still a problem in the third world, especially for individuals already afflicted with paralysis who have to be physically and socially rehabilitated. The main impact of disability for most of the patients is in mobility-related activities (Grimby and Jonsson, 1994). Victims of poliomyelitis have complained of fatigue, muscle weakness, reduced endurance and gait problems (Lonnberg, 1993). Energy requirements of ambulation when both lower limbs are paralysed have been investigated. Metabolic rate was found to be at least three

CORRESPONDENCE:
T K Hamzat
Department Of Physiotherapy
College Of Medicine
University Of Ibadan
Oyo State, Nigeria

times more than the basal rate accompanied by significant increases in heart rate when patients ambulate with crutches.

The physiotherapist utilises various physical modalities to, among other things, strengthen the weak or paralysed muscles, prevent joint contracture and correct deformities. The physiotherapist also prescribes the use of supportive and assistive devises like a lumbar corset, spinal jacket, ring top caliper, crutches and walking sticks.

In the physical rehabilitation of victims of poliomyelitis in Nigeria, it is uncommon to include health promoting physical exercise programmes that may enhance cardio-respiratory conditioning of the victims in order to improve ambulatory ability. This may be due to a lack of information on the benefits of such programs for individuals with poliomyelitis. Rimmer (1999) earlier indicated a strong need to establish linkages between rehabilitation facilities and community based fitness programs in order to extend the rehabilitation process into the community. Therefore the specific aim of this pilot study was to evaluate some simple immediate cardiovascular responses in individuals with poliomyelitis to the nine-minute walk/run test (Matthews, 1978) in order to infer the physical weakness or otherwise of the subjects. The outcome may provide a rationale basis for inclusion of health promoting physical exercise programs in rehabilitation interventions in individuals with a history of lower limb muscle paralysis due to poliomyelitis.

MATERIALS AND METHODS

Two groups of subjects participated in this study. The first group included 15 male and female patients (aged 7-27 years) with paralytic poliomyelitis affecting both lower limbs, who were ambulating each using a pair of above-knee calipers and a pair of crutches. The subjects did not have a history of participating routinely in physical activities. Each participant in the first group was matched for age with normal participants in the second group who served as control. Also, the 15 male and female subjects in the control group (aged 7-27 years) did not have a history of participating routinely in physical activities.

PROCEDURE

On each day of administration of the test, the following data were collected from subjects from the two groups:

Age (years): the chronological age of each subject was recorded in years as age at the last birthday.

Height (cm): With the subject in supine lying on a plinth, height was measured as the vertical distance between the vertex of the head to the inferior border of the heels of the feet. This technique was used because of the inability of the polio patient to stand erect without calipers. The same procedure was also used for subjects in the control group.

Weight (kg): Body weight was measured using a conventional portable weighing scale. Due to the inability of the paralytic polio patient to stand unsupported, each patient stood on the scale, putting on the pair of calipers and supported by a pair of crutches. The total weight was recorded. The patient disembarked from the scale and the supporting aids were measured alone. Weight of the aids was subtracted from the total weight to get the patient's body weight. The subjects in the control group were weighed directly on the scale. Each subject wore a vest and a pair of shorts when the body weight was being determined.

Blood pressure (mmHg) and heart rate (beats/min): The resting cardiovascular variables were measured after each subject had rested for a minimum period of ten minutes. The blood pressure was measured, with each subject in the sitting position using a sphygmomanometer and stethoscope. Heart rate was counted as pulse rate at the radial artery on the subject's left wrist using a stop-watch.

THE EXERCISE TEST

Each individual with poliomyelitis was allowed to put on the pair of calipers, and was instructed to walk, or fast-walk, or run at his/her own comfortable, self-selected walking velocity with the aid of a pair of crutches. The self-selected velocity was reported to be the most efficient walking speed from an energy conservation point of view (Nielson et al, 1990). The stop-watch was started and at the 9th minute the patient was asked to stop the ambulation exercise, and the blood pressure and heart rate were measured. Throughout the course of the 9-minute walk/run, subjects were closely monitored by the researcher to avoid any untoward physical and medical incidents.

TREATMENT OF DATA

From the measurements taken, the rate pressure product was computed for each participant before and after the exercise test.

rate pressure product =
systolic blood pressure x heart rate

For all the variables determined, means and standard deviations were computed. The independent t-test was utilized to compare the resting and post exercise parameters of the polio patients and their age-matched control subjects (Bailey, 1991). The level of significance was set at $p<0.05$.

RESULTS

The physical characteristics of the subjects in the two groups are shown in table 1, indicating a significant difference ($p<0.05$) in the mean height and body weight. The mean resting rate pressure product of individuals with poliomyelitis was significantly higher ($p<0.05$) than that of the control group (Table 2). Comparing the immediate post exercise cardiovascular parameters of the subjects, the mean values of the heart rate and rate pressure product of individuals with poliomyelitis were significantly higher ($p<0.05$) than corresponding values in the control group (Table 3). The mean heart rate of individuals with poliomyelitis increased by almost 21% immediately after the 9-minute walk/run test, but there were no appreciable changes in the systolic and diastolic blood pressures. Similarly, there were no significant changes in the cardiovascular parameters in the control group.

DISCUSSION

People with physical disabilities are highly susceptible to secondary health conditions affecting, among others, fitness and endurance. Health promoting strategies would reduce or eliminate these secondary health problems. Rimmer (1999) indicated that most professionals get little training in exercise prescription for people with disabilities. The author recommended that the major compo-

Table 1. Physical characteristics of subjects.

Physical parameters	Group 1 mean(sd)	Control mean(sd)	t value	p level
Height (cm)	133.0(15.8)	163.4(22.9)	4.23	0.000*
Weight (kg)	41.9(12.1)	55.7(11.1)	3.277	0.003*
BMI	23.8(6.7)	21.1(3.1)	1.44	0.159

*Statistically significant ($p<0.05$)

Table 2. Resting cardiovascular parameters of the subjects.

Cardiovascular parameters	Group 1 mean(sd)	Control mean(sd)	t value	p level
Heart rate (b/min)	73.6(15.1)	75.6(10.3)	0.424	0.675
SBP (mmHg)	106.1(13.5)	103.8(7.6)	0.581	0.566
DBP (mmHg)	64.4(9.5)	68.9(10.8)	1.201	0.24
RPP	9088.3(1279.7)	7950.4(1084.3)	2.627	0.014*

*Statistically significant ($p<0.05$)
SBP = Systolic blood pressure, DBP = Diastolic blood pressure, RPP = Rate pressure product

Table 3. Immediate post exercise cardiovascular parameters.

Cardiovascular parameters	Group 1 mean(sd)	Control mean(sd)	t value	p level
Heart rate (b/min)	88.9(18.1)	72.7(6.6)	3.268	0.003*
SBP (mmHg)	108.7(13.7)	108.5(7.8)	0.049	0.961
DBP (mmHg)	66.5(9.9)	69.3(7.1)	0.891	0.380
RPP	9722.3(2068.4)	7899.5(1060.7)	3.037	0.005*

*Statistically significant ($p<0.05$)
SBP = Systolic blood pressure, DBP = Diastolic blood pressure, RPP = Rate pressure product

nents of a fitness program for people with disabilities should include cardiovascular endurance.

In the current study, the rate pressure product was the only resting cardiovascular parameter that was significantly different between the subjects with poliomyelitis and the control subjects. The post exercise heart rate and rate pressure product were significantly higher in the poliomyelitis subjects. Heart rate has been reported to have a linear relationship with oxygen demands of the heart (Kispert, 1987). Therefore there was a higher oxygen demand on the hearts of poliomyelitis subjects while they were taking part in the nine-minute walk/run test. This observation was further reinforced by the significantly higher post-exercise rate pressure product in subjects with poliomyelitis. Rate pressure product is a useful index of cardiac stress and a valid predictor of myocardiac oxygen consumption (Kispert, 1987). These outcomes are suggestive of a need to assist the subjects in conserving energy during ambulation by improving endurance. Physical activity has been identified as a very cost effective, as well as more enjoyable, health promotive measure in individuals with physical disability (Katsumura and Hinman, 1997).

CONCLUSION

Preventing secondary health conditions by empowering people with physical disabilities to take control of their own health will be more cost-effective than watching them decline in function from a lack of good health maintenance. Physiotherapists should join in the collective effort to enrich the lives of people with disabilities. Therefore, the inclusion of exercise training programs that will enhance cardio-respiratory conditioning in victims of poliomyelitis is advisable in order to reduce the energy demand in ambulatory activities. The changes will also enhance the quality of life of the affected individuals (Rimmer, 1999).

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