

## Original Article



# Effects of Physical Exercise on Urinary Albumin-Creatinine Ratio and Blood Pressure in Type 2 Diabetic Male with Microalbuminuria

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### Abstract

**Background:** Microalbuminuria is a microvascular complication of diabetes mellitus. Physical exercise has effects on urinary albumin-creatinine ratio and blood pressure in type 2 diabetic male with microalbuminuria.

**Objective:** To assess the effects of physical exercise on urinary albumin-creatinine ratio and blood pressure in type 2 diabetic male with microalbuminuria.

**Materials and Methods:** This prospective interventional study was carried out in the Department of Physiology, Sir Salimullah Medical College (SSMC), Dhaka between 1st July 2015 and 30th June 2016. Total thirty (30) type 2 diabetic male with newly diagnosed microalbuminuria (urinary albumin-creatinine ratio 30-299 mg/g), age ranged from 45 to 60 years were selected by purposive consecutive sampling from Out Patient Department of Endocrinology, Sir Salimullah Medical College and Mitford Hospital, Dhaka. Previously prescribed oral hypoglycemic and antihypertensive drugs were maintained, and the participants were instructed not to change their diet habits during the study period. All the participants were asked to perform moderate aerobic physical exercise, consisting of 30-40 minutes walking/day, 5 days/week, at an intensity of 50-70% of maximum heart rate (HRmax) for a total duration of 90 days. All the subjects were studied two times: before performing physical exercise i.e. on day-1 (Phase A) and after performing physical exercise for 90 days i.e. on day-91 (Phase B). Urinary creatinine level was estimated by fix time kinetic method and urinary albumin level was estimated by immunometric assay method. Urinary albumin-creatinine ratio was measured by calculation. Moreover, blood pressure was also measured. For statistical analysis, paired sample "t" test was performed.

**Results:** In this study, urinary albumin-creatinine ratio, systolic and diastolic blood pressure were significantly ( $p < 0.001$ ) decreased in type 2 diabetic male with microalbuminuria after performing physical exercise for 90 days in comparison to those of their pre exercise values.

**Conclusion:** From this study it may be concluded that, physical exercise significantly decreased urinary albumin-creatinine ratio, systolic and diastolic blood pressure in type 2 diabetic male with microalbuminuria.

**Key words:** Physical exercise, type 2 diabetes mellitus, microalbuminuria, urinary albumin-creatinine ratio, blood pressure.

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### Introduction

Type 2 diabetes is initially caused by decreased sensitivity of target tissues to the metabolic effect of insulin.<sup>1</sup> Individuals with diabetes are at risk of developing microvascular complications such as nephropathy, retinopathy, neuropathy etc.<sup>2</sup> Microalbuminuria is one of the most common diabetic microvascular complications. It is the earliest sign of diabetic nephropathy.<sup>3</sup> It is a sign of abnormal vascular function and increased vascular permeability. In microalbuminuria, urinary albumin-creatinine ratio is 30-299 mg/g in spot urine sample.<sup>4</sup> The prevalence of microalbuminuria is 4.6 % in diabetes mellitus patients.<sup>5</sup> Micro

albuminuria may progress to overt nephropathy which is the most common cause of end-stage renal disease and an important cause of morbidity and mortality.<sup>6</sup> The basis for the prevention of microalbuminuria is the treatment of its risk factors such as hyperglycemia, hypertension and dyslipidemia.<sup>7</sup>

Exercise is planned, structured and repetitive bodily movement performed to improve or maintain one or more components of physical fitness.<sup>8</sup> Physical activity has protective effects on the vascular endothelium.<sup>9</sup> Maintained podocyte numbers with improvements in oxidative damage and chronic inflammation,

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might be the beneficial effects of exercise in diabetic kidney disease.<sup>10</sup> In chronic hyperglycemia, intracellular glucose causes production of advanced glycation end products (AGEs) which may contribute to renal damage.<sup>2</sup> Therefore, careful glycemic control may reduce both hyperfiltration and microalbuminuria in the early stage of diabetic nephropathy.<sup>11</sup> Aerobic exercise decreased fasting blood glucose level and systolic blood pressure in type 2 diabetic patients.<sup>12,13</sup>

A human study revealed that after one year follow up urinary albumin-creatinine ratio significantly decreased among patients with macroalbuminuria in adequate physical activity group.<sup>14</sup> In few experimental animal studies, urinary albumin-creatinine ratio was found significantly decreased after performing exercise.<sup>7,15</sup>

However, in another human study urinary albumin-creatinine ratio was non-significantly increased in diabetic patients with microalbuminuria after 1km treadmill walk. But urinary albumin-creatinine ratio returned to baseline 2 hour after exercise.<sup>16</sup>

Several studies showed significantly decreased systolic and diastolic blood pressure after performing exercise.<sup>17,18</sup> Whereas, some studies found no significant change in systolic and diastolic blood pressure after performing exercise.<sup>19</sup>

There is little information about the effects of exercise on urinary albumin-creatinine ratio and blood pressure in type 2 diabetes mellitus patients with microalbuminuria. So, this study has been designed to observe the effects of physical exercise on urinary albumin-creatinine ratio and blood pressure in type 2 diabetic male with microalbuminuria. It is expected that the findings of this study will be beneficial for type 2 diabetic male with microalbuminuria as well as for the physician of faculty of endocrinology for better management of microalbuminuria.

## Materials and Methods

This prospective interventional study was carried out in the Department of Physiology, Sir Salimullah Medical College (SSMC), Dhaka between 1st July 2015 and 30th June 2016. Total thirty (30) type 2 diabetic male with newly diagnosed microalbuminuria (urinary albumin-creatinine ratio 30-299 mg/g), age ranged from 45 to 60 years were selected by purposive consecutive sampling from Out Patient Department of Endocrinology, Sir Salimullah Medical College and Mitford Hospital, Dhaka. Ethical permission was taken from the Institutional Ethics Committee (IEC) of Sir Salimullah Medical College. After proper counseling, the aim, objectives, risk and the procedure of the study were explained in details to the subjects. Written informed consent was taken from the subjects. Then their general information (personal, medical, family and occupation) and data were collected and all the information were recorded in a prefixed questionnaire. Previously prescribed oral hypoglycemic and antihypertensive

drugs were maintained, and the participants were instructed not to change their diet habits during the study period. All the participants were asked to perform moderate aerobic physical exercise, consisting of 30-40 minutes walking/day, 5 days/week, at an intensity of 50-70% of maximum heart rate (HRmax) for a total duration of 90 days. All the subjects were studied two times: before performing physical exercise i.e. on day-1 (Phase A) and after performing physical exercise for 90 days i.e. on day-91 (Phase B). Five (5) ml of first morning urine sample was collected in sterile glass test tube from each participant for estimation of urinary albumin and creatinine levels. Urinary albumin level was estimated by immunometric assay method and urinary creatinine level was estimated by fix time kinetic method in the laboratory of the Department of Biochemistry, Sir Salimullah Medical College, Dhaka. However, urinary albumin-creatinine ratio was measured by calculation. Blood pressure was also measured. Statistical analysis was done by paired sample 't' test. P value  $\leq 0.05$  was accepted as level of significance. Statistical analysis was performed by using a computer based statistical program SPSS version-22.

## Results

The mean ( $\pm$ SD) urinary albumin-creatinine ratio of the subjects were 85.03 $\pm$ 8.93 and 57.62 $\pm$ 8.26 mg/g in phase A and phase B respectively. In this study, the mean ( $\pm$ SD) urinary albumin-creatinine ratio was significantly ( $p < 0.001$ ) decreased in phase B in comparison to that of phase A. (Table I and Figure 1).

The mean ( $\pm$ SD) systolic blood pressure of the subjects were 133.93 $\pm$ 4.56 and 121.73 $\pm$ 2.86 mm of Hg and diastolic blood pressure were 83.46 $\pm$ 3.74 and 77.20 $\pm$ 2.85 mm of Hg in phase A and phase B respectively. In this study, the mean ( $\pm$ SD) systolic and diastolic blood pressure of the subjects were significantly ( $p < 0.001$ ) decreased in phase B in comparison to those of phase A. (Table II and Figure 2).

**Table I:** Urinary albumin, urinary creatinine and urinary albumin-creatinine ratio in type 2 diabetic male with microalbuminuria (n=30)

Parameters	Phase A	Phase B	P value
Urinary albumin (mg/L)	63.23 $\pm$ 5.0 9 (55 - 71)	42.93 $\pm$ 5.6 3 (33 - 50)	0.000 ** *
Urinary creatinine (mg/dl)	75.10 $\pm$ 9.5 2 (60 - 94)	75.16 $\pm$ 9.6 2 (60 - 95)	0.804 ns
Urinary albumin - creatinine ratio (mg/g)	85.03 $\pm$ 8.9 3 (71.76 - 98.48)	57.62 $\pm$ 8.2 6 (45.65 - 74.62)	0.000 ** *

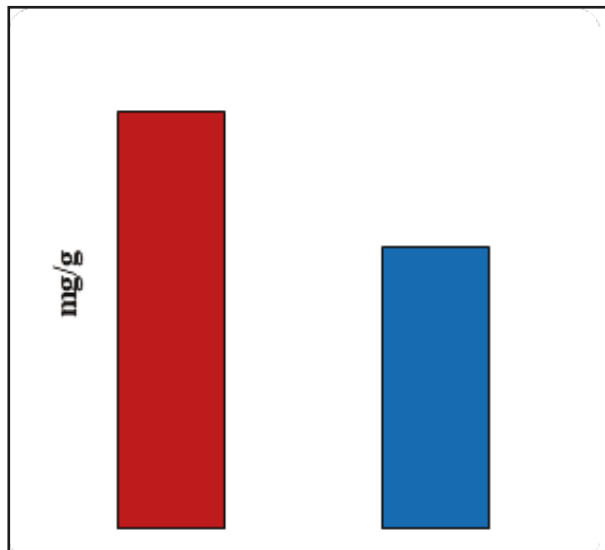
**Table II:** Blood pressure in type 2 diabetic male with microalbuminuria (n=30)

Parameters	Phase A	Phase B	P value
Systolic blood pressure (mm of Hg)	133.93±4.56 (128 -140)	121.73±2.86 (116 -126)	0.000 ***
Diastolic blood pressure (mm of Hg)	83.46±3.74 (80 -90)	77.20±2.85 (72 -80)	0.000***

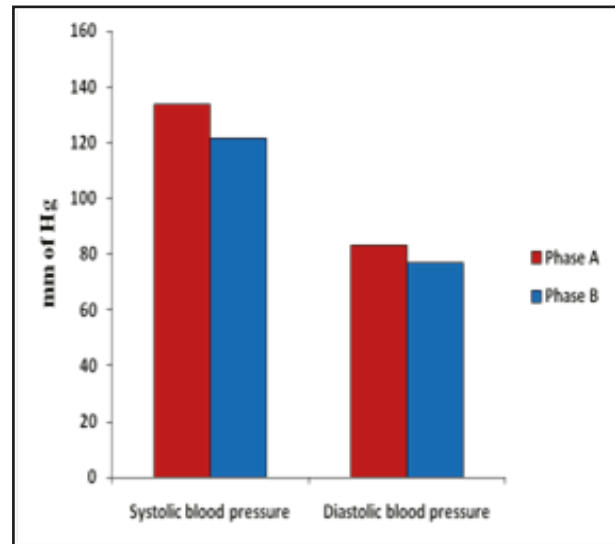
**Phase A:** Before performing physical exercise (Control, on day-1)

**Phase B:** After performing physical exercise (Study, on day-91)

\*\*\*= Significant at P<0.001; ns= Non significant; n= Total number of subjects



**Figure 1:** Mean urinary albumin-creatinine ratio in type 2 diabetic male with microalbuminuria (n=30)



**Figure 2:** Mean blood pressure in type 2 diabetic male with microalbuminuria (n=30)

Phase A: Before performing physical exercise (Control, on day-1)

Phase B: After performing physical exercise (Study, on day-91)

n= Total number of subjects

### Discussion

In this study, the mean urinary albumin-creatinine ratio was significantly decreased in the subjects after performing physical exercise in comparison to that of before exercise value. Similar findings were observed by some other investigators of different countries.<sup>15, 20-25</sup> On the other hand, urinary albumin-creatinine ratio found significantly increased 1 hour after exercise which returned to baseline 2 hour after exercise.<sup>16</sup> Though exact mechanisms of these effects could not be revealed directly from the present study, several researchers of different countries proposed various suggestions on these aspects, which might be cause of our present findings. It has been suggested that, moderate exercise reduces albuminuria and oxidative damage.<sup>7</sup> Again, increased nitric oxide production and suppression of advanced glycation end products (AGEs) production following long-term exercise reduces urinary albumin-creatinine ratio.<sup>24</sup> Moreover, decreased urinary albumin-creatinine ratio is associated with decreased fasting blood glucose level and decreased systolic blood pressure.<sup>25</sup> In addition, intensive blood pressure control decreases the rate of progression of microalbuminuria.<sup>26</sup>

In this study, the mean systolic and diastolic blood pressure were significantly (p<0.001) decreased after performing physical exercise in comparison to those of pre exercise values. In a recent study, significantly decreased systolic and diastolic blood pressure were found on thirty (30) male with metabolic syndrome (mean age 54±8 years) after performing 16 weeks of moderate aerobic exercise on treadmill (54 minutes walking/-day and 3 times/week).<sup>17</sup> Again, significantly decreased systolic and diastolic blood pressure were found in forty one (41) hyper

tensive type 2 diabetic male (age ranged from 40-70 years) after performing 12 weeks of exercise at low to vigorous intensity (45 minutes/day and 3-5 times/week).<sup>18</sup>

Another study on eighty (80) type 2 diabetic patients of both sex, age ranged from 33-69 years revealed significantly decreased systolic and diastolic blood pressure in moderate aerobic (20-60 minutes treadmill walking/session), resistance (60-80% of one repetition maximum) and combined exercise groups after performing physical exercise 3 times weekly for 1 year in comparison to that of their pre exercise values.<sup>12</sup> Similar observations were also made by some other investigators.<sup>27</sup>

On the other hand, there was no significant change in systolic and diastolic blood pressure were in twenty (20) previously sedentary type 2 diabetic patients (age ranged from 45-65 years) after performing 10 weeks of moderate aerobic exercise (30 minutes/day and 3 times/week)<sup>19</sup>. Another study also showed no change in blood pressure after exercise.<sup>28</sup> Whereas, in a human study significantly decreased systolic blood pressure was found but there was no significant difference in the diastolic blood pressure in type 2 diabetic patients after performing combined aerobic and resistance exercise 3 times per week for 6 months.<sup>29</sup>

It has been suggested that, aerobic exercise decreases blood pressure through reduction of vascular resistance. Decreased activity of autonomic nervous system causes reduction in blood pressure. Reduced plasma renin activity suggested that reduction in the activity of sympathetic nervous system affects kidney which is the most potent factor in long-term blood pressure regulation.<sup>30</sup> Moreover, long-term exercise attenuates blood pressure which is associated with increased urinary sodium excretion.<sup>31</sup> Again, it has been suggested that aerobic exercise increased production of nitric oxide, leading to vasodilation and subsequent decrease in arterial blood pressure.<sup>17</sup> Decreased sympathetic nervous system activity following exercise results decreased systolic blood pressure<sup>32,33</sup> and diastolic blood pressure falls may be due to decrease in peripheral vascular resistance by producing vasodilation through accumulation of metabolites like carbon dioxide and hydrogen ion.<sup>32</sup> Reduction in body weight leads to reduction in renin, angiotensinogen and aldosterone levels in plasma which may contribute to decrease blood pressure.<sup>34</sup> In addition, short-term glycemic control resulted in reduction of blood pressure in type 2 diabetic patients.<sup>35</sup>

## Conclusion

From this study it may be concluded that, physical exercise significantly decreased urinary albumin - creatinine ratio, systolic and diastolic blood pressure in type 2 diabetic male with microalbuminuria. Although, further study is needed to elucidate the exact mechanism responsible for these effects.

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