

# Comparative Analysis of Serum Magnesium Levels in Alcoholic and Non-Alcoholic Patients with Type 2 Diabetes Mellitus

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## ABSTRACT

**Background:** It is estimated that 343 million people throughout the world are suffering from type 2 Diabetes mellitus. Alcohol use produces decreased serum magnesium levels in diabetes patients, so a vicious cycle is initiated in diabetes patient. **Objective:** The aim of this study was to find out the effect of alcoholism on serum magnesium levels in diabetic type 2 patients. **Study Design:** It was a cross-sectional study. **Settings:** It was conducted in the Physiology Department of Sindh University Jamshoro in association with the Diabetic OPD of Liaquat University Hospital, Pakistan. **Duration:** From January 2022 to April 2022 (3 months). **Methods:** The sample size was comprised of 220 patients who were divided into two groups. The control group consisted of 140 Type 2 diabetic patients with no history of alcoholism, and the test group consisted of 80 diabetic Type 2 patients with alcoholism. A Roche C3-11 auto analyser was used to estimate the serum magnesium level. Blood sugar was calculated by a Care Sens N Glucometer Model No. GM 505 Pad. **Results:** Those who were suffering from diabetes mellitus and were alcoholics were significantly more suffering from hypomagnesaemia ( $P$  value 0.0002, odds ratio = 3.9, likelihood ratio = 1.81) and Obesity ( $p = 0.040$ ). **Conclusion:** Patients with type 2 diabetes mellitus who are addicted to alcohol have a higher chance of having hypomagnesemia.

**Keywords:** Alcoholism, Diabetes mellitus, Hypomagnesemia, Obesity, Roche C3 11 autoanalyzer.

## INTRODUCTION

The advances in industrialisation have improved the living standards of the human population, but this improvement has some costs. This has increased stress, which acts as a predisposing factor in the generation of new diseases. Diabetes mellitus is one of those diseases that is marked as one of the leading diseases in today's world. Diabetes mellitus is a multisystem syndrome that is characterised by an increased glycaemic level extracellularly and hypoglycaemia within the cells.<sup>1</sup> Diabetes mellitus is divided into four broad groups according to its aetiology: type 1 diabetes mellitus is caused by an inappropriate secretion of insulin, while type 2 diabetes mellitus is caused by an impaired interaction of insulin with its receptors. The other forms

of diabetes mellitus are caused by poor hormone metabolism, particularly growth hormone and glucagon. Gestational diabetes mellitus typically develops during pregnancy<sup>2</sup>. Diabetes mellitus is spreading throughout the world as an epidemic disorder. It is estimated that 100 million Americans and four hundred million people in other areas of the global map are suffering from these disabling diseases.<sup>3</sup> This proportion is going to increase soon, as an estimated 300 million people are suffering from pre-diabetes throughout the world.<sup>4</sup> It is feared that by the year 2045, seven hundred million people, both male and female, will be fighting this disorder.<sup>5</sup>

Different researchers believe that dietetic supplementation rich in magnesium usually prevents type 2 diabetes mellitus, and most hyperglycaemic

patients usually have low serum magnesium in their diet.<sup>6</sup> As a multisystem syndrome, the long-term development of type 2 diabetes mellitus leads to neurological, cardiac, and vascular complications causing myocardial infarction, angina pectoris, and different neuropathies.<sup>7</sup> The serum level of magnesium in the human body is 75 mmol, and deficiency below this level causes malfunctioning in the cardiovascular, central nervous system, and metabolic functions.<sup>8</sup> Cardiovascular strokes are produced by impaired haemostasis because magnesium impedes overactive platelet aggregation in different areas of the cardiovascular system.<sup>9</sup>

There are different causes of decreased serum magnesium levels, including decreased intake in the diet, dehydration, and excessive loss through the gastrointestinal tract from diarrhoea or malabsorption.<sup>10</sup> An increase in magnesium loss may occur because of renal disease or the excessive use of diuretics.<sup>11</sup> Hypomagnesemia not only produces diabetes mellitus, but it is also a basic cause of the conversion of pre-diabetes into full-fledged diabetes syndrome.<sup>12</sup> There are three reasons behind the aetiology of diabetes mellitus due to hypomagnesemia: first, it increases the serum level of glucagon; second, it decreases insulin release from beta cells; and third and foremost, it decreases the interaction of insulin with its receptors.<sup>13</sup> Hypomagnesemia also leads to obesity because of impaired cholesterol metabolism, which, in turn, will lead to developing diabetes mellitus.<sup>14</sup>

Alcohol use leads to different complications, including chronic liver disease, cardiovascular diseases, and stroke. Alcohol produces inflammation in the gastrointestinal tract and urinary tract, leading to decreased absorption and increased loss of magnesium, leading to hypomagnesemia in diabetic patients and further worsening of the condition. Many studies have shown that alcohol consumption up to moderate levels in diabetic patients is linked with liver fibrosis, and chronic use of alcohol in diabetic patients leads to increased serum levels of serum endotoxin and will lead to the development of hypomagnesemia in diabetic patients.<sup>15,16</sup>

The aim of this study was to find out the effect of alcoholism on serum magnesium levels in diabetic type 2 patients.

## METHODS

This was a cross-sectional study that was conducted in the Physiology Department of Sindh University Jamshoro in association with the Diabetic OPD (Outpatient Department) of LUH (Liaquat University Hospital Hyderabad) from 01-January 2022 to 30-April 2022. The study was approved by the Institutional Review Board of

the Department of Physiology, Sindh University Jamshoro/ERC no. Physiol/27, dated March 10, 2020. A total of 220 patients were selected, both male and female. The age limit was 40 to 60 years of age. To conduct the study, two groups were created: a control group of 140 patients comprising diabetic Type 2 patients with no history of alcohol consumption. The other group was a case group comprised of eighty patients (n = 80) with type 2 diabetes mellitus (HbA1C greater than 6.5%) and a history of alcohol usage spanning more than two years made up the test group. The random blood sugar level was monitored by a Care Sens N Glucometer Model No. GM 505 Pad.

Before taking the sample and history of the patient, written consent was obtained, and the whole procedure was explained to the participants. Only type 2 diabetic patients were selected. A history of alcohol intake was taken, and only those patients were selected in the test group who had been addicted to alcohol for more than 2 years. By using the aseptic technique, 3 ml of blood was collected from a prominent vein and transfused into a test tube with a red rubber cap. It was immediately sent to the research lab. A Roche C311 auto analyser was used to estimate the serum magnesium level.

GraphPad Prism5 was used to analyse the data, and the significance was judged by a *P* value less than 0.05. The Fisher's exact test was applied to observe the significance, odds ratio, likelihood ratio, specificity and sensitivity.

## RESULTS

The current study was comprised of n=220 patients, with n=140 in the diabetic non-alcoholic group and n=80 in the alcoholic, diabetic group. The BMI was 32.72± 2.14 in the test group and 22.72 ± 1.72 in the control group. One hundred and forty patients were in the diabetic and non-alcoholic, and eighty participants were in the diabetic and alcoholic groups.

**Table 1: Hypomagnesaemia in diabetes without alcohol use versus Diabetes with alcohol use**

Variables	Normal serum Magnesium	Hypomagnesemia	Total	<i>p</i> -value	95% CI
Diabetic without alcoholism	116 (52.72%)	24 (10.90%)	140 (63.63%)	0.0002	1.21to 1.86
Diabetic with alcoholism	44 (20%)	36 (16.36%)	80 (36.36%)		
Total	160 (72.72%)	60 (27.27%)	220 (100%)		

Table 1 shows that those who were suffering from diabetes mellitus and were alcoholic were significantly more suffering from Hypomagnesemia (*P* value 0.0002)

than those who were diabetic and non-alcoholic. Hypomagnesemia was detected 3.9 times (Odds ratio 3.9, likelihood ratio 1.81), greater in alcoholic than non-alcoholic patients.

## DISCUSSION

This study aims to investigate the relationship between the prevalence of hypomagnesemia in alcoholic and non-alcoholic type 2 diabetic patients. It was a cross-sectional study carried out from January 1, 2022, to April 30, 2022, at the Department of Physiology of Sindh University Jamshoro in collaboration with Liaquat University Hospital in Hyderabad after getting approval from the university's ethical board. The sample size of this study was comprised of 220 participants, and they were divided into two groups: the control group (n = 140) and the case group (n = 80). All participants were told about the purpose of this study and what procedures would be used. After informed consent, written consent was taken in their native languages, so every participant understood the point written in the consent form, and all participants were allowed to withdraw at any moment during the study without affecting their medical management outcome.

The study results show that those who were suffering from diabetes mellitus and were alcoholics were more likely to have hypomagnesemia (P value 0.0002) than those who were diabetic and non-alcoholic. With an odds ratio of 3.9 and a likelihood ratio of 1.81, the results of this study were comparable to those conducted by researchers globally. Jargin SV *et al.* show similar results of differences in serum magnesium levels between alcoholics and non-alcoholic patients who were also diabetic, with a p-value less than 0.005.<sup>17</sup> P Kumar *et al.* showed that hypomagnesaemia was more common in alcoholic diabetics than non-alcoholic diabetics, with a P-value < 0.01.<sup>18</sup> Arancibia-Hernández YL *et al.* also found that hypomagnesaemia was present in 45% of diabetic alcoholic patients in comparison to non-alcoholic diabetic patients.<sup>19</sup> MB Khattak *et al.* also found that after magnesium supplement, the prevalence of hypomagnesaemia in diabetic alcoholics reduced up to a greater extent with a P-value < 0.01.<sup>20</sup> Lynette J Oost *et al.* demonstrated that alcoholics with diabetes need to have magnesium supplementation because they are more prone to having hypomagnesaemia than non-alcoholic diabetic, P-value < 0.01.<sup>21</sup> A Hernández-Rubio *et al.* also showed that patients with diabetes who were alcoholics had a higher prevalence of hypomagnesaemia (P-value < 0.05).<sup>22</sup> But there is another aspect of this relationship that is opposed by many researchers as well. G Liamis *et al.* didn't find any significant relation in the difference of serum magnesium levels between alcoholic diabetic and non-alcoholic diabetic patients, P-value > 0.05.<sup>23</sup> JL Kröse *et al.*, J Baj *et al.*, W Bosman *et al.*, and AA Mathew *et al.*

showed that magnesium levels were similar in diabetic alcoholic and non-alcoholic patients, P-value > 0.05.<sup>24-25-26-27</sup>

## CONCLUSION

The whole discussion concludes that diabetes mellitus leads to hypomagnesemia, and hypomagnesaemia causes poor glycemic control. It is also highlighted that alcohol users are more likely to become victims of poor glycaemic control and hypomagnesaemia,

## LIMITATIONS

The limitations of this study are firstly that it is a cross-sectional study, secondly the small sample size, and thirdly, its results finding are applicable only to a specific population.

## SUGGESTIONS / RECOMMENDATIONS

It is recommended that people who are type 2 diabetics and also alcoholics make sure that they don't have any other medical issues like kidney disease that could lead to an altered blood level of magnesium.

## CONFLICT OF INTEREST / DISCLOSURE

None.

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