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Examination of Serum Magnesium Levels in Individuals with Muscle Pain

Seda Evyapan Aydın[1] and Gökhan Aydın[2,*]
[1]Faculty of Sport Sciences, Uşak University, Uşak, Türkiye
[2]Department of Family Medicine, Afyonkarahisar Health Sciences University, Afyonkarahisar, Türkiye
Correspondence: gokanay@hotmail.com

Abstract Muscle pain is a common clinical complaint with multiple possible causes, including musculoskeletal, metabolic, and neuromuscular conditions. Because magnesium contributes to cellular energy metabolism and neuromuscular function, its status may be relevant when evaluating individuals who report muscle pain. This descriptive study examined serum magnesium concentrations in 108 individuals who presented to a family health center with complaints of muscle pain. The lowest recorded magnesium concentration was 1.42 mg/dL, and the highest was 2.48 mg/dL. The mean concentration was 2.02 mg/dL, with a standard deviation of 0.17 mg/dL. The observed skewness and kurtosis values were -0.14 and 1.18, respectively. Normality testing yielded a Kolmogorov–Smirnov p-value of 0.200 and a Shapiro–Wilk p-value of 0.292, providing no evidence of a statistically significant departure from a normal distribution in these tests. Mean serum magnesium concentrations were 2.01 mg/dL among female participants and 2.04 mg/dL among male participants; the reported difference was not statistically significant ($p = 0.409$). The overall mean fell within the reference interval of 1.7–2.2 mg/dL used by the cited clinical laboratory, although individual observations extended below and above that interval. Because the study includes no asymptomatic comparison group or quantitative assessment of pain severity, the measurements characterize magnesium status among symptomatic attendees but cannot establish whether magnesium concentration is associated with the occurrence or intensity of muscle pain.

Index Terms Serum magnesium; Muscle pain; Magnesium status; Neuromuscular function; Clinical biochemistry; Descriptive study

I. Introduction

Magnesium is among the most abundant minerals in the human body and is essential for normal physiological functioning. Much of the body's magnesium is located in bone and intracellular compartments, whereas only a small fraction circulates in extracellular fluids. Consequently, the concentration detected in a routine serum sample represents a limited portion of total body magnesium stores. This distribution is clinically important because extracellular concentrations may be maintained within a comparatively narrow interval despite changes in tissue magnesium availability. Magnesium participates in cellular energy metabolism, protein synthesis, ion transport, and the maintenance of normal muscular and neurological activity [1], [2].

Magnesium is required for numerous enzyme-mediated reactions, particularly those involving adenosine triphosphate (ATP). It contributes to membrane stability, the regulation of neuronal excitability, the transmission of nerve signals, and the physiological processes involved in muscle contraction and relaxation. Disturbances in magnesium homeostasis may therefore affect neuromuscular function. However, a physiological role for magnesium does not, by itself, establish that low magnesium concentration explains any particular complaint of muscle pain. Clinical interpretation must consider symptoms, associated conditions, nutritional intake, renal function, concurrent medications, and the limitations of the biomarker being measured [1]–[3].

Magnesium and calcium have interrelated roles in controlling neuromuscular excitability and muscular activity. Clinically significant magnesium depletion may be accompanied by muscle spasms, weakness, or other neurological manifestations. Nevertheless, muscle pain and skeletal muscle cramps are not identical clinical outcomes, and not all forms of pain or cramping are attributable to magnesium deficiency. Evidence from controlled trials and systematic reviews does not establish a consistent benefit of routine magnesium supplementation for common idiopathic muscle cramps in older adults. Accordingly, the biological plausibility of a relationship must be distinguished from the effectiveness of magnesium treatment and from an association demonstrated in a specific clinical sample [4], [5].

Serum magnesium is a routinely accessible laboratory

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measurement used in clinical evaluation, although it is an imperfect indicator of the body's total magnesium reserves. Reference intervals vary among laboratories and depend on the analytical method and the population for which the interval was established. UCSF Health reports an illustrative serum reference interval of 1.7–2.2 mg/dL; results outside this interval must be interpreted with the patient's clinical history and the reporting laboratory's reference limits rather than being classified in isolation [6]. Diagnostic interpretation can be strengthened by considering dietary intake and other relevant clinical or biochemical information when available.

Against this clinical background, the present study sought to describe serum magnesium concentrations among individuals attending a family health center because of muscle pain and to examine whether the reported concentrations differed according to sex. The emphasis is on describing the observed clinical sample, its distribution of measured serum concentrations, and the extent to which those results can be interpreted in relation to commonly used reference limits. The study does not include a symptom-free comparison group and therefore cannot determine the prevalence of magnesium abnormalities in the general population or quantify the independent association between magnesium status and muscle pain.

II. Methods

A. Study Population and Data Sources

The study sample comprised 108 individuals who presented to Uşak Şehit Sadık Akın Family Health Center with complaints of muscle pain and met the study's stated inclusion criteria. The original research record identifies the clinical setting and final sample size but does not provide the recruitment dates, detailed eligibility criteria, participant age distribution, or number of female and male participants. Those details should be supplied from the primary study records when available to support transparent interpretation and reproducibility.

A demographic information form developed by the researchers was used to collect participant characteristics, including sex and age. Clinical information and serum magnesium measurements were retrieved from patient medical records. The original description does not identify the laboratory instrument or analytical assay, the timing of blood sampling, or the procedures used to evaluate possible preanalytical influences on serum magnesium concentration. Therefore, the laboratory results are reported as recorded rather than attributed to an unverified testing procedure.

B. Statistical Analysis

The data were analyzed using IBM SPSS Statistics. The distribution of magnesium measurements was assessed by the Kolmogorov–Smirnov and Shapiro–Wilk tests, together with descriptive skewness and kurtosis statistics. The Shapiro–Wilk procedure is a standard test of departures from a normal distribution, although no single diagnostic provides conclusive proof that a dataset is normally distributed [7], [8]. Descriptive statistics were used to summarize sample size, minimum and maximum concentrations, the mean, and the standard deviation. The reported group comparison used an independent-samples t-test to examine magnesium concentrations according to sex; the significance threshold was $p < 0.05$. The available source does not report the group sizes, variance-homogeneity test, confidence interval for the mean difference, or test statistic, so these quantities cannot be independently reconstructed. General statistical guidance emphasizes interpreting a test result alongside the study design and the distributional evidence rather than treating a nonsignificant normality test as proof of normality [9].

III. Results

A. Distribution of Serum Magnesium Concentrations

The outcomes of both normality tests are summarized in Table 1. The Kolmogorov–Smirnov test statistic was 0.065 ($p = 0.200$), and the Shapiro–Wilk statistic was 0.985 ($p = 0.292$). Neither test rejected its null hypothesis at the prespecified 0.05 significance level. Together with the descriptive shape statistics, these results were considered compatible with an approximately normal distribution for the purposes of the reported analysis. This interpretation does not imply that exact normality has been demonstrated.

Table 1: Normality Tests for Serum Magnesium Concentrations

Variable	Kolmogorov–Smirnov Statistic	p-Value	Shapiro–Wilk Statistic	p-Value
Serum magnesium	0.065	0.200	0.985	0.292

The distribution of the recorded magnesium concentrations is additionally represented by the histogram in Figure 1. The histogram is intended to complement the numerical normality tests by displaying the observed sample distribution; its detailed appearance must be checked against the original figure image before final publication.

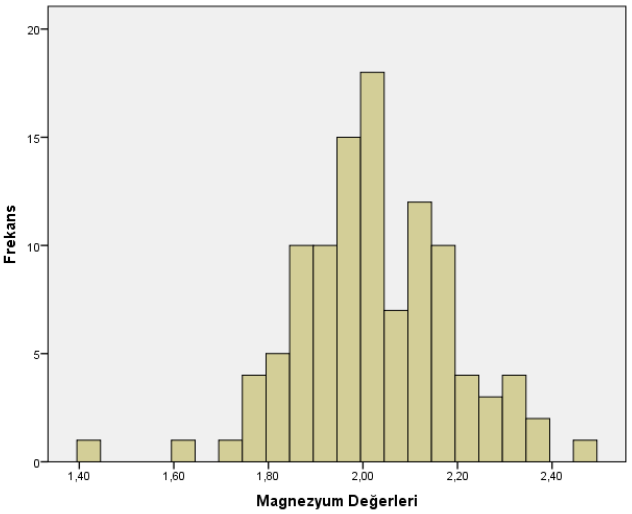


Figure 1: Distribution of Serum Magnesium Concentrations Among Study Participants

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Table 2 presents the descriptive statistics for the 108 participants. The minimum magnesium concentration was 1.42 mg/dL, and the maximum was 2.48 mg/dL, giving an observed range of 1.06 mg/dL. The mean serum magnesium concentration was 2.02 mg/dL, with a standard deviation of 0.17 mg/dL. The reported skewness was -0.14 and kurtosis was 1.18. These values suggest comparatively modest departures from symmetry and the reference kurtosis used in the original analysis, although their interpretation must remain consistent with the statistical convention applied by the software [8].

Table 2: Descriptive Statistics for Serum Magnesium Concentrations

Variable	Sample Size	Minimum	Maximum	Mean	Standard Deviation	Skewness	Kurtosis	Unit
Serum magnesium	108	1.42	2.48	2.02	0.17	-0.14	1.18	mg/dL

B. Comparison of Magnesium Concentrations by Sex

The recorded comparison according to sex is provided in Table 3. The mean concentration was 2.01 mg/dL with a standard deviation of 0.18 mg/dL for female participants and 2.04 mg/dL with a standard deviation of 0.14 mg/dL for male participants. The reported independent-samples t-test yielded $p = 0.409$. Therefore, no statistically significant between-sex difference was detected at the chosen significance threshold. Because the number of participants in each sex group was not supplied, the precision of the estimated difference and the statistical power of the comparison cannot be evaluated from the available summary alone.

Table 3: Comparison of Serum Magnesium Concentrations According to Sex

Sex	Mean (mg/dL)	Standard Deviation (mg/dL)	p-Value
Female	2.01	0.18	–
Male	2.04	0.14	0.409

IV. Discussion

In this descriptive sample of 108 individuals who reported muscle pain, the mean serum magnesium concentration was 2.02 ± 0.17 mg/dL, and individual measurements ranged from 1.42 to 2.48 mg/dL. The mean lies within the 1.7–2.2 mg/dL clinical reference interval reported by UCSF Health [6]. However, the observed range includes concentrations below and above this illustrative interval. At least one participant therefore had a recorded result below its lower limit, and at least one had a result above its upper limit. The available aggregate statistics do not establish how many participants fell outside the reference interval, so the proportion with low or high magnesium cannot be estimated from the reported range alone.

The study results also require interpretation in light of the physiological compartmentalization of magnesium. Only a small proportion of magnesium is located in circulating serum, whereas the majority is found in bone and intracellular tissues. Serum concentration is valuable for detecting certain clinically important abnormalities but does not provide a complete measurement of total body magnesium reserves. Workinger and colleagues emphasize the diagnostic limitations of isolated serum measurements and the need to interpret magnesium status in its wider clinical and nutritional context [3]. Therefore, a mean value within the reference interval should not be interpreted as evidence that every individual in this sample had adequate magnesium reserves.

The distinction between biochemical status and clinical symptoms is especially relevant here. Every participant was selected because of a complaint of muscle pain; the study does not report symptom severity, duration, underlying diagnosis, or an otherwise comparable group without pain. Consequently, the findings cannot establish whether lower serum magnesium is associated with greater pain or whether magnesium deficiency is more frequent among symptomatic than asymptomatic individuals. Magnesium has well-established roles in neuromuscular function, but the outcomes of supplementation trials for common muscle cramps are heterogeneous. A Cochrane systematic review concluded that magnesium supplementation is unlikely to provide clinically meaningful prevention of idiopathic skeletal muscle cramps among older adults, and a randomized trial of magnesium oxide also did not establish a benefit for nocturnal leg cramps over placebo [4], [5]. Those studies concern cramping rather than all forms of muscle pain; they inform the broader clinical context but do not directly test the present study's question.

Related educational and clinical literature also emphasizes magnesium's contribution to normal metabolism. Baysal described magnesium as an essential mineral associated with cardiovascular and other physiological functions, although that editorial source should not be treated as evidence of a causal relationship between magnesium deficiency and a particular disorder [10]. In an experimental animal study, Boskey and colleagues observed changes in bone mineral properties and reduced metaphyseal osteocalcin under short-term magnesium deficiency; these findings concern bone metabolism and do not provide direct evidence about muscle pain in human participants [11]. Geçkalan and Civan discussed the relevance of magnesium and other nutrients for athletes, including energy metabolism and neuromuscular function, while the wider clinical literature cautions against inferring a supplementation benefit solely from such physiological roles [12]. Özata likewise provided a general discussion of the importance of magnesium for human health, which can be read as contextual background rather than as a source of participant-specific clinical evidence [13].

The reported sex-based comparison does not indicate a statistically significant difference in average serum magnesium concentration between female and male participants. Nonetheless, the absence of a statistically significant result is not proof of equivalent concentrations across groups. Reporting group sizes, confidence intervals, and relevant clinical covariates would allow more informative evaluation of this comparison. Additional details regarding magnesium assay methods, participant selection, relevant medication use, renal function, dietary intake, and the presence of conditions that

can cause muscle pain would also improve the interpretability and reproducibility of the study.

Future research could examine whether biochemical magnesium measurements are associated with quantified pain severity after adjustment for possible confounding factors. Such an investigation would require prospectively defined outcomes, a suitable comparison group, standardized laboratory procedures, and a transparent analytic plan. Measuring dietary magnesium intake or additional biomarkers when clinically indicated could further help distinguish inadequate intake from altered magnesium handling and other causes of muscle symptoms. These proposals are directions for subsequent investigation, not analyses that were conducted in the present study.

V. Conclusion

The present study describes serum magnesium concentrations in 108 individuals who attended a family health center with complaints of muscle pain. The observed mean was 2.02 ± 0.17 mg/dL, with recorded concentrations ranging from 1.42 to 2.48 mg/dL. The overall mean fell within the 1.7–2.2 mg/dL reference interval cited for comparison, although individual values extended beyond both ends of that interval. The reported distributional tests did not identify a statistically significant departure from normality, and the comparison according to sex did not reveal a statistically significant difference ($p = 0.409$). Because serum magnesium provides only a partial assessment of total body magnesium status, and because the study contains no asymptomatic comparison group or standardized measure of pain severity, the findings should be interpreted as descriptive rather than evidence of a causal or statistically established relationship between magnesium and muscle pain. Further studies with detailed clinical information and appropriately designed comparisons are required to evaluate that relationship.

Author Contributions

All authors contributed equally to the conception and design of the study, data collection and analysis, and the drafting and critical revision of the manuscript. All authors have read and approved the final version of the manuscript.

Conflict of Interest

The authors declare no conflicts of interest regarding this manuscript.

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Data Availability

No data was used for the research described in the article.

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