Randomized Controlled Trial

Does Oral Chromium Withstand Steroid Hyperglycemia in Postinterventional Ultrasound-guided Sacroiliac Joint Injections in Patients With Diabetes: A Double Blind Randomized Controlled Trial

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Background: Steroid-induced hyperglycemia is a significant concern for patients with diabetes who undergo ultrasound-guided sacroiliac joint (SIJ) injections, because corticosteroids impair insulin sensitivity and elevate blood glucose levels. Chromium, a trace mineral essential for glucose metabolism, has been suggested to enhance insulin sensitivity and stabilize blood glucose levels. While previous studies indicate that chromium supplementation may reduce hyperglycemia and analgesic use, further research is needed to confirm its efficacy in patients with diabetes who are receiving steroid therapy.

Objectives: Our study aimed to evaluate the effects of oral chromium supplementation on steroid-induced hyperglycemia and pain management in patients with diabetes who are undergoing SIJ injections.

Study Design: A double-blinded, randomized controlled trial.

Setting: This study was conducted at Fayoum University Hospitals (June 2024 through May 2025).

Methods: We randomized 60 patients with diabetes who underwent an SIJ injection. They were randomized into 2 groups: the Chromium Group (n = 30) received 200 µg of oral chromium daily for 45 days postintervention, while the Control Group (n = 30) followed standard diabetes management. Primary outcomes included random blood sugar and hemoglobin A1c levels, while secondary outcomes assessed were hypoglycemic medication use, analgesic consumption, pain scores, and adverse effects.

Results: Our study found that oral chromium supplementation significantly improved glycemic control and reduced the need for hypoglycemic drugs and analgesics in patients with diabetes who underwent steroid therapy. Starting from the postintervention sixth day, there were significant reductions in blood sugar levels and a 40% decrease in hypoglycemic drug use from the first postintervention week ($P < 0.05$). Analgesia consumption decreased by 30%, with improved pain perceptions noted in Visual Analog Scale pain scores at postintervention months one, 3, and 6 ($P < 0.05$). These results indicate that chromium is efficacious for managing both glycemia and pain, leading to enhanced treatment outcomes.

Limitations: Limitations include the relatively small total number of patients, which might limit the ability to generalize the findings to all populations that have diabetes or detect smaller but clinically meaningful effects. The supplementation period of 45 days may not be long enough to observe potential long-term effects of chromium on blood sugar levels or fully assess any delayed adverse effects.

Conclusions: Chromium supplementation improves glycemic control and reduces analgesic dependence in patients with diabetes who had an SIJ injection. Chromium supplementation therapy is a safe and cost-effective adjunct to standard diabetes management.

Key words: Steroid-induced hyperglycemia, chromium supplementation, diabetes, sacroiliac joint injections, glycemic control, pain management

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Hyperglycemia is a recognized side effect of corticosteroid use, especially in patients with diabetes (1,2). Corticosteroids should not to be spared for their marked anti-inflammatory benefit for managing pain and inflammation in several musculoskeletal disorders, including sacroiliac joint dysfunction, which is commonly seen in lower back and pelvic pain. This pain substantially affects mobility and quality of life (3,4). Even though ultrasound-guided sacroiliac joint injections are efficient for pain management, they typically include corticosteroids, which may complicate diabetes since they lead to transient but significant increases in blood glucose levels. Untreated hyperglycemia can exacerbate long-term complications such as neuropathy, nephropathy, and cardiovascular diseases (5).

Chromium, a trace essential element that plays a role in glucose and lipid metabolism, has been suggested to positively influence insulin sensitivity and glycemic control, particularly in type 2 diabetes management (6,7). Our study investigated the potential of oral chromium supplementation. The dosage we used was based on prior studies demonstrating improved glycemic control without significant adverse effects (8,9).

This dosage was used to mitigate hyperglycemia caused by corticosteroid therapy in patients with diabetes who underwent an ultrasound-guided sacroiliac joint injection, addressing an important research gap.

Our study is essential because of the many complex ways that corticosteroids cause hyperglycemia, including increased hepatic gluconeogenesis, decreased peripheral glucose absorption, and impaired insulin release (2,10). Although current treatments, such as dietary and insulin dose adjustments, have been researched, they might not be completely effective in resolving the initial glucose spikes following an injection (11,12), As a cost-effective, noninvasive, and accessible method of treating certain metabolic disorders, our study suggests chromium supplementation is efficacious.

By conducting a comparative analysis of patients with diabetes who underwent a sacroiliac joint injection and who did or did not receive chromium supplementation and comparing their blood glucose levels at various time points, our research was able to indicate how effective chromium is in such instances. This can potentially lead to improved clinical protocols for treating hyperglycemia in patients with diabetes who undergo steroid therapy, thereby significantly improving their overall outcome.

Objectives

Our prospective, double-blinded, randomized controlled study, conducted at the Pain Management Clinic and Interventional Radiology Unit, Department of Anaesthesia, Faculty of Medicine, Fayoum University Hospitals from June 2024 through May 2025, examined chromium's short-term effect on postintervention glucose levels and the broader implications for diabetic musculoskeletal management protocols. Successful proof of the efficacy of chromium may lead to revised clinical guidelines and improved patient management strategies, thereby significantly improving quality of life and reducing the risk of serious diabetic complications.

Methods

Our study was a randomised controlled trial with simple randomisation to ensure unbiased participant allocation into either the Chromium Group or the Control Group. Patients were enrolled from a hospital-based pain management clinic or an interventional radiology department. The study was registered with ClinicalTrials.gov under identifier NCT06709313.

Study Population and Eligibility Criteria

Inclusion Criteria:

- Adult patients (Aged ≥ 18 years)
- Patients fulfilled the American Diabetes Association diagnostic criteria for diabetes mellitus
- Stable baseline blood glucose
- On a stable antidiabetes regimen.

Exclusion Criteria:

- Chromium supplements contraindications
- History of chromium allergy
- Pregnant or lactating women
- Diabetes not controlled (hemoglobin A1c > 9%)

- Major comorbid conditions
- Significant lumbar spine deformity
- Class 2 or severe obesity (body mass index [BMI] ≥ 35 kg/m²)
- Local Infection.

Randomization and Blinding

A computer-generated sequence was used to randomly assign patients in a 1:1 ratio to either the Chromium Group or the Control Group. Allocation was concealed using sealed, opaque, sequentially numbered envelopes. Group assignments were unknown to patients and outcome assessors, while chromium supplementation capsules and placebo capsules were identical in appearance, ensuring that the double-blinded design was preserved.

Group Assignment and Intervention Information

Patients in the Chromium Group (n = 30) were administered oral chromium supplementation at 200 µg daily for 45 postintervention (8,9). This dose was selected based on prior research assessing its safety and efficacy in modulating glucose metabolism. Patients received daily logs to register their adherence to the supplementation regimen, which was confirmed through periodic follow-up calls and pill counts.

The Control Group (n = 30) did not receive any chromium supplementation but continued with their usual diabetes management regimen.

Minimization of harm was a goal of our study. Side effects due to chromium supplementation or the sacroiliac joint injections were monitored in both groups. Well-being was maintained with regular follow-ups. Patients received emergency treatment if an undesirable reaction occured, such as infection or dysregulation in blood glucose levels, which was not encountered in any patient. Patients from both groups were also told to report side effects, to allow for a speedy and efficient resolution.

An independent committee supervised our study's implementation and monitored adverse events to ensure ethical compliance. Serious adverse events were reported immediately according to the protocol to the Institutional Review Board and relevant authorities. To improve safety and support, patients had immediate access to the research team and medical professionals. In emergencies requiring urgent care, the protocol helped manage serious events, especially those involving injections or supplementation, which was not encountered. Integrity was preserved through the reporting of all results regardless of their nature. Patients were told their data would be used only to advance the understanding of the study's findings and contribute to greater scientific knowledge. It was essential to preserve trust, ethics, and transparency.

Procedure

Following approval from the Institutional Review Board of the Scientific Research Ethics Committee (Committee number M725, Approval number 119 dated June 9, 2024), eligible patients signed a detailed informed consent form before recruitment and randomization.

The local protocol for examining and treating patients was strictly adhered to btoh groups. This involved taking the patient's history, performing physical examinations, and using provocation tests to assess sacroiliac joint dysfunction. Diagnostic tests (Gaenslen's Test; Patrick's Test, also known as the FABER [Flexion, Abduction, External Rotation] Test; and compression and distraction tests) were helpful in diagnosing the source of sacroiliac pain.

Before any intervention, several investigations were conducted to assess the patient's medical fitness and identify any possible risks or contraindications. These included liver function tests, random blood glucose levels, serum creatinine and electrolytes, complete blood count, and electrocardiogram. The purpose of each test was to check for any health issues a patient had—whether liver or kidney function, or cardiaovacular risks—to ensure that the patient could receive the intervention Patients were given detailed instructions on using the Visual Analog Scale (VAS) for pain. Pain intensity at pre- and postintervention was measured using this scale, ranging from 0 to 100 mm in order to account for interindividual differences in reporting pain relief (8,9).

Patients were administered 2 mg of intravenous midazolam for light sedation and anxiolysis, making sure the patient was relaxed and comfortable during the procedure. The initial intravenous access was facilitated with a 20-G cannula. Continuous monitoring of the patient's physiology was carried out throughout the procedure including constant electrocardiogram, blood pressure, and oxygen saturation level to ensure patient safety. Ultrasound-guided injections were performed using a high-resolution ultrasound system (Philips ClearVue 350, Philips Heathcare, Andover, MA, USA) equipped with a high-frequency linear array transducer (Active Array L12-4, 8-13 MHz). A 22-G, 50

mm echogenic needle (Stimuplex® D; B. Braun, Germany) was used for the injection. This configuration offered high-resolution images, which assisted in accurately guiding the echogenic needle into the sacroiliac joint. The visibility of the needle and its length were the best balance to minimize risk and pain during the injection. The Chromium Group's safety, comfort, and well-being were monitored closely throughout all stages of the study, including patient preparation and ultrasound-guided injection. All procedures were performed by trained health professionals experienced in these procedures to the best clinical standards. Patient safety and treatment efficacy were ensured through continuous monitoring and the immediate response to adverse effects or complications.

Study Outcomes

Primary Outcome

- Levels of random blood sugar.

Secondary Outcomes

- Doses of oral hypoglycemics pre- and postintervention.
- Total analgesic consumption Pre- and postintervention

VAS score

- Negative effects of chromium supplementation
- 6-week hemoglobin A1c levels.

Data Collection

Blood glucose levels were assessed with glucometers or with laboratory testing. Adverse effects were recorded through self-reporting and clinical assessments, so efficacy and safety were closely monitored.

Ethical Considerations

Before signing up, we ensured that all patients had a clear understanding of the study's purpose, procedures, risks, and benefits. They were aware they could exit the study at any point without consequences. The Institutional Review Board approved the study and followed all ethical standards. To protect the privacy of our study patients, we assigned unique identification numbers to all personal and medical information, and limited access to this sensitive data strictly on a need-only basis.

Statistical Analysis

Data were analyzed using IBM SPSS Statistics 26 (IBM Corporation). Descriptive statistics summarizing characteristics were used, t tests or χ^2 tests were used to compare differences between groups as appropriate. The Shapiro-Wilk test was used to check the normality of the data. Statistical significance was defined as a $P < 0.05$.

Sample Size

The sample size required for this randomized controlled trial was calculated to identify a statistically significant difference in fasting plasma glucose levels in both groups. Based on previous research (8), and using a standard deviation of 1.5 mm, MedCalc Statistical Software 20.0 (MedCalc Software, Ltd) determined that 30 per group was required. This included a buffer to accommodate potential withdrawals, and thus powered the study to detect relevant differences in fasting plasma glucose levels.

Results

We assessed 73 patients were for eligibility; 8 did not meet the criteria, and 5 refused to participate. The remaining patients were randomly allocated into 2 equal groups (30 patients each). All allocated patients were followed up and analyzed statistically (Fig. 1).

Random blood sugar was not significantly different statistically between groups at postintervention days one, 2, 3, 4, and 5. It was significantly lower statistically at postintervention days 6 and 7 and weeks 2, 3, and 6 in the Chromium Group ($P < 0.05$).

The need for hypoglycemic drugs was not significantly different statistically at preintervention between the groups. The need was significantly lower statistically at postintervention weeks one, 2, 3, 4, 5, and 6 in the Chromium Group ($P < 0.05$). Preintervention analgesia consumption was not significantly different statistically between the groups. It was significantly lower in the Chromium Group at postintervention weeks one, 2, 3, 4, 5, and 6 ($P < 0.05$).

VAS scores were significantly lower at postintervention months one, 3, and 6 months in the Chromium Group ($P < 0.001$). Creatinine, sodium, potassium, and chloride levels were not significantly different between the groups postintervention. Hemoglobin A1c levels were statistically significantly lower in the Chromium Group ($P < 0.001$).

Discussion

The potentiation of insulin activity is the mechanism by which chromium regulates blood glucose. Significantly less insulin is needed when chromium is present in a usable form. Because there are more insu-

lin receptors, more chromium increases the amount of insulin that binds to cells (13). The hyperglycemic clamp approach has also increased β cell sensitivity and glucose consumption (14). Additionally, insulin receptor tyrosine kinase is activated by chromium (15,16). Our study highlights a marked improvement in glycemic control in the Chromium Group, with significant reductions in random blood sugar levels starting from the sixth postintervention day (Table 1).

In our analysis, laboratory parameters indicated that kidney function, as reflected by mean creatinine levels, was comparable between the Chromium Group (0.9 mg/dL ± 0.12) and the Control Group (0.99 mg/dL ± 0.25), with no statistically significant difference (P = 0.087). Electrolyte levels were stable across both groups, as shown by similar sodium (138.92 mEq/L ± 2.72 vs 138.72 mEq/L ± 3.42; P = 0.806) and potassium levels (4.13 mEq/L ± 0.54 vs 4.18 mEq/L ± 0.61; P = 0.738). Chloride levels also showed no statistically significant variance (102.42 mEq/L ± 3.15 vs 103.33 mEq/L ± 3.69; P = 0.308), supporting metabolic stability under study conditions. However, a notable and statistically significant result was observed in the hemoglobin A1c levels, which were substantially lower in the Chromium group (7.08% ± 0.33) compared to the Control Group (8.93% ± 0.31; P < 0.001) (Table 2).

The days immediately following the intervention showed no statistically significant differences in all groups; however, a consistent and significant decrease was observed at later time points (postintervention days 6 and 7 and weeks 2, 3, and 6), suggesting chromium's role in stabilizing blood glucose levels over time. These findings indicate chromium supplementation could benefit patients with diabetes in managing acute glycemic excursions typically associated with steroid therapy. Oral chromium supplementation enhances the metabolic profile of patients with diabetes over time, which is central to managing diabetes and reducing the risk of complications (17,18) (Table 1).

Our analysis also revealed that the use of hypoglycemic drugs was significantly lower in the Chromium Group from the first postintervention week onward. This reduction not only supports the therapeutic efficacy of chromium in reducing the need for an additional pharmacological intervention, but also suggests potential cost benefits in managing diabetes (19), particularly in patients undergoing steroid therapy, which is known to disrupt glucose metabolism (Table 3).

In addition, the data demonstrate a significant decrease in analgesia consumption in the Chromium Group across all postintervention measurements, starting as early as the first week. This suggests an additional benefit of chromium in managing pain, possibly through mechanisms that involve anti-inflammatory actions or modulation of pain thresholds. The consistent reduction across the 6 postinterven-

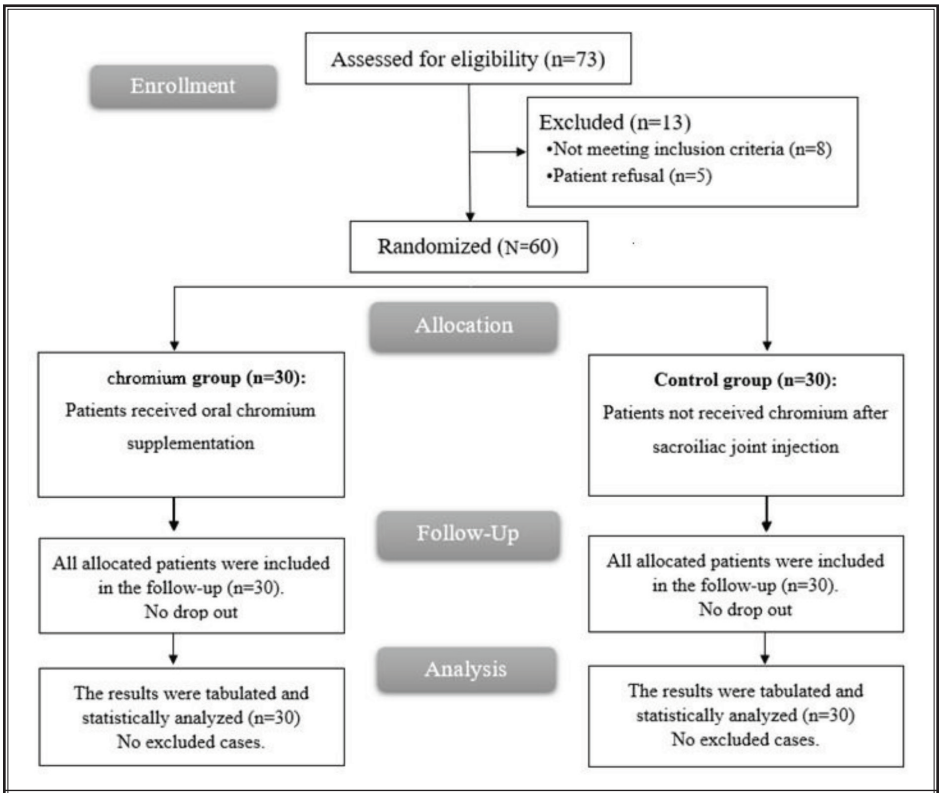


Fig. 1. *Consolidated Standards of Reporting Trials (CONSORT) flowchart of the enrolled patients.*

Table 1. *Random blood sugar levels in mg/dL of the studied groups represented as mean (SD).*

Postintervention	Chromium Group (n = 30)	Control Group (n = 30)	*P* Value
One day	175.93 ± 22.42	176.5 ± 26.18	0.929
2 days	175.23 ± 19.24	181.23 ± 22.16	0.267
3 days	176.17 ± 21.39	177.77 ± 22.41	0.778
4 days	169.87 ± 17.55	172.93 ± 22.76	0.561
5 days	172.3 ± 17.07	168.27 ± 20.04	0.405
6 days	165.17 ± 17.32	175.17 ± 17.81	0.031*
7 days	168.67 ± 14.76	178.73 ± 17.12	0.018*
2 weeks	158.37 ± 15	167.07 ± 18.44	0.049*
3 weeks	155.3 ± 12.91	162.3 ± 12.71	0.039*
6 weeks	141.77 ± 9.02	149.4 ± 12.22	0.007*

*Statistically significant at $P \leq 0.05$

Table 2. *Laboratory investigations of the studied groups postintervention.*

		Chromium Group (n = 30)	Control Group (n = 30)	*P* Value
Creatinine (mg/dL)	Mean (SD)	0.9 ± 0.12	0.99 ± 0.25	0.087
	Range	0.7 - 1.1	0.6 - 1.4	
Sodium (mEq/L)	Mean (SD)	138.92 ± 2.72	138.72 ± 3.42	0.806
	Range	134.9 - 142.8	133.2 - 144	
Potassium (mEq/L)	Mean (SD)	4.13 ± 0.54	4.18 ± 0.61	0.738
	Range	3.4 - 5	3.3 - 5.3	
Chloride (mEq/L)	Mean (SD)	102.42 ± 3.15	103.33 ± 3.69	0.308
	Range	97.3 - 107.3	96.9 - 110	
Hemoglobin A1c (%)	Mean (SD)	7.08 ± 0.33	8.93 ± 0.31	< 0.001*
	Range	6.5 - 7.5	8.5 - 9.5	

*Statistically significant at $P \leq 0.05$

tion weeks further aligns with the improvements in VAS scores as shown in Table 4, indicating enhanced pain perception and potentially better overall pain management (Tables 4,5). The VAS scores, as detailed, were significantly lower at postintervention months one, 3, and 6 months in the Chromium Group. These scores show the long-term benefits of chromium in reducing pain perception, which could be attributed to its effects on inflammatory cytokines or insulin sensitivity. The statistically significant differences in VAS scores not only complement the findings related to analgesia consumption, but also highlight the dual role of chromium in managing both glycemic control and pain, enhancing quality of life for patients with diabetes. Chromium supplementation maintained a favorable safety profile, with no significant adverse effects reported. This reassurance of safety is crucial for the broader application of chromium as a therapeutic adjunct in clinical practice, especially considering the chronic nature of diabetes and the frequent need for long-term interventions.

Demographics and Baseline Characteristics

Age, gender, weight, height, and BMI were comparable between the 2 groups. Specifically, the mean patient age in the Chromium Group was 31.7 (SD, 7.66) years and in the Control Group it was 31.63 (SD,5.53) years ($P = 0.969$). The mean weight in the Chromium Group was 72.13 kg (SD, 10.36 kg)and in the Control Group it was 71.20 kg (SD, 6.86 kg) ($P = 0.682$). Heights were similar: in the Chromium Group the mean height was 168.73 cm (SD, 7.09 cm) and in the Control Group it was 168.00 cm (SD, 4.98 cm) ($P = 0.645$). BMI also showed no statistically significant differences: the mean BMI in the Chromium Group was 25.34 (SD, 3.43) and in the Control Group it was 25.24 (SD, 2.43) ($P = 0.900$).

Complete Blood Count (CBC) Tests

CBC tests, including hemoglobin, hematocrit, white blood cell count, and platelets, showed no statistically significant differences between the groups. In the Chromium Group, mean (SD) hemoglobin levels were 13.97 g/dL ± 1.31 g/dL and in the Control Group it was 14.21 g/dL ± 1.49 g/dL ($P = 0.505$). In the Chromium Group, mean (SD) hematocrit percentages were 42.27% ± 3.75% and in the Control Group it was 41.67% ± 4.07% ($P = 0.555$). White blood cell and platelet counts also showed no statistical significance differences between the groups ($P = 0.566$ and $P = 0.296$, respectively).

Liver Function Tests

Liver function tests, including alanine aminotransferase, aspartate aminotransferase, alkaline phosphatase, and bilirubin levels were also statistically insignificant between the groups. In the Chromium Group, alanine aminotransferase mean (SD) levels were 24.95 IU/L ± 6.39 IU/L and in the Control Group it was 27.88 IU/L ± 7.31 IU/L ($P = 0.105$). Similar trends were observed for aspartate aminotransferase, alkaline phosphatase, and bilirubin, with *P* values of 0.757, 0.086, and 0.098, respectively.

Other Laboratory Investigations

Additional laboratory parameters such as creatinine, sodium, potassium, and chloride levels also showed no statistically significant differences. Mean (SD) creatinine levels were 0.9 mg/dL ± 0.12 mg/dL in the Chromium Group and 0.99 mg/dL ± 0.25 mg/dL in the Control Group (P = 0.087). Sodium and potassium, had P values of 0.806 and 0.738, respectively.

While managing inflammation, corticosteroids can disrupt glucose metabolism, necessitating careful management to prevent blood sugar complications in patients treated with steroids (20,21).

Studies such as those conducted by Ravina, et al (22), Suksomboon, et al (8), and Kim, et al (23) have demonstrated the potential of chromium supplementation for reversing corticosteroid-induced diabetes and improving insulin sensitivity. These studies collectively support our findings. Ravina, et al (22) reported significant reductions in fasting blood glucose and hypoglycemic drug needs, accompanied by increased urinary chromium losses following steroid treatment. This suggests a link between steroid-induced diabetes and chromium excretion, reinforcing the hypothesis that chromium losses during steroid therapy may exacerbate hyperglycemic conditions. Similarly, Kim, et al (23) reported that chromium supplementation mitigated the adverse effects of dexamethasone, such as weight loss and elevated glucose levels, and enhanced insulin sensitivity in rats, supporting chromium's role in enhancing insulin action.

Furthermore, a meta-analysis by Suksomboon, et al (8) further validated chromium's efficacy, showing a significant reduction in hemoglobin A1c (-0.55%; P = 0.001) and fasting plasma glucose (-1.15 mmol/L; P = 0.001), particularly with doses exceeding 200 µg/d. These results align closely with our findings, particularly in demonstrating chromium's ability to improve glycemic control while reducing pharmacological dependency. Barker, et al (24) highlighted the prevalence and clinical challenges of glucocorticoid-induced hyperglycemia, emphasizing the necessity for effective management strategies, which could include micronutrient supplementation. Additional context-specific evidence comes from Ghosh, et al (25). They found improved glycemic control with chromium supplementation among Indian patients with type 2 diabetes, indicating effective chromium action across different populations. Lewicki, et al (26) also discussed the therapeutic roles of chromium in metabolic disorders, acknowledging the beneficial effects of chromium on glucose and lipid metabolism, particularly in disordered states such as steroid-induced conditions.

Table 3. *Hypoglycemic drug usage in mean (SD) grams.*

	Chromium Group (n = 30)	Control Group (n = 30)	*P* Value
Preintervention	976.1 ± 244.75	1084.33 ± 224.04	0.079
One week postintervention	886.8 ± 241.64	1015.23 ± 251.65	0.048*
2 weeks postintervention	815.7 ± 213.81	988.67 ± 224.75	0.003*
3 weeks postintervention	757.67 ± 206.26	874.73 ± 238.98	0.047*
4 weeks postintervention	721.77 ± 196.82	830.53 ± 203.4	0.040*
5 weeks postintervention	692.4 ± 163.89	793.63 ± 182.88	0.028*
6 weeks postintervention	655.97 ± 157.88	767.9 ± 198.22	0.019*

*Statistically significant at $P \leq 0.05$

Table 4. *Visual Analog Scale mean (SD) scores of the studied groups.*

Postintervention	Chromium Group (n = 30)	Control Group (n = 30)	*P* Value
One month	4 (3-5)	5 (5-6)	< 0.001*
3 months	3 (2-4)	4 (4-5.75)	< 0.001*
6 months	2 (1-3)	3 (2-4)	< 0.001*

*Statistically significant at $P \leq 0.05$

Table 5. *Analgesia consumption of the studied groups.*

	Chromium Group (n = 30)	Control Group (n = 30)	*P* Value
Preintervention	48.2 ± 11.75	53.07 ± 11.41	0.109
One week postintervention	40.07 ± 11.74	47 ± 11.25	0.023*
2 weeks postintervention	33.63 ± 9.92	43.83 ± 10.51	< 0.001*
3 weeks postintervention	31.47 ± 7.12	39.33 ± 9.94	0.001*
4 weeks postintervention	25.73 ± 8.23	32.7 ± 8.17	0.002*
5 weeks postintervention	23.5 ± 5.67	32.33 ± 7.6	< 0.001*
6 weeks postintervention	20.93 ± 6.55	28.2 ± 7.05	< 0.001*

*Statistically significant at $P \leq 0.05$

Together, these studies validate chromium's therapeutic potential in mitigating steroid-induced metabolic disturbances and highlight the broader applicability and clinical relevance of chromium supplementation in diverse

populations that have diabetes, especially under conditions of metabolic stress induced by steroid treatments.

In the context of these findings, our study specifically investigated oral chromium supplementation as a treatment for managing steroid-induced hyperglycemia in patients with diabetes who are receiving sacroiliac joint injections; this differs from prior research that broadly examined chromium's effects on metabolic health (27,28).

Strengths and Limitations

The use of a double-blind, randomized controlled trial design is a major strength, since it minimizes bias and allows for clear comparisons of the effects of chromium supplementation between our Chromium Group and Control Group. Focusing specifically on this patient population enhances the applicability and relevance of our findings to a particular clinical scenario. Moreover, our study's comprehensive assessment of both primary outcomes—such as random blood sugar levels—and secondary outcomes—including hypoglycemic drugs, analgesic consumption, VAS scores, and potential adverse effects—provides a well-rounded view of the effectiveness and safety of chromium supplementation. Ethical adherence, with approval from an institutional review board and informed consent from all patients, reflects our study's commitment to high ethical standards.

Despite its strengths, our study has limitations, including a relatively small number of patients, which might limit the ability to generalize the findings to all populations that have diabetes or detect smaller but clinically meaningful effects. The supplementation period of 45 days might not be long enough to observe the potential long-term effects of chromium on blood sugar levels or fully assess any delayed adverse effects.

We can conclude that chromium supplementation offers a dual benefit in patients with diabetes who are undergoing sacroiliac joint injections by improving glycemic control and reducing pain and medication dependence. Given its favorable safety profile, low cost, and ease of administration, chromium presents a promising adjunct to conventional diabetes and pain management strategies.

Recommendations

Clinical Implementation

Given the demonstrated benefits of chromium supplementation in improving glycemic control and reducing hyperglycemic excursions, it is recommended that chromium be considered as an adjunct therapy for patients with diabetes who are undergoing steroid treatment.

Investigation of Chromium's Analgesic and Anti-inflammatory Effects

The observed reduction in pain scores and analgesic consumption suggests chromium's potential anti-inflammatory and analgesic role. Further research, including mechanistic studies and large-scale clinical trials, is warranted to explain the pathways through which chromium influences pain modulation and inflammation.

Long-term Safety and Efficacy Studies

While 6-month postintervention data from this study confirm improvements in glycemic control and pain relief, the long-term metabolic and vascular effects of chromium supplementation remain unclear. Future studies should investigate whether the observed benefits persist over extended periods and assess their potential effect on insulin resistance, vascular complications, and chronic pain management in populations that have diabetes.

Personalised Supplementation Approaches

Considering the variability in individual responses to chromium, future research should focus on identifying patient subgroups that would benefit most from supplementation. Factors such as baseline insulin sensitivity, dietary chromium intake, genetic predisposition, and metabolic profile should be explored to develop personalized dosing strategies that optimize clinical outcomes while avoiding unnecessary supplementation in nonresponders.

Economic and Cost-effectiveness Analysis

Given the observed reduction in hypoglycemic drug requirements, a cost-effectiveness analysis should be conducted to evaluate chromium supplementation as a potential strategy to reduce the economic burden of diabetes management. If proven cost-effective, incorporating chromium supplementation into hospital and outpatient diabetes care protocols could improve patient outcomes while minimizing health care costs.

Conclusion

Our data demonstrate that oral chromium supplementation is an effective strategy for managing ste-

roid-induced hyperglycemia in patients with diabetes who are undergoing sacroiliac joint injections, notably improving metabolic profiles and pain management. The integration of chromium into standard care regimens could significantly enhance the quality of life and treatment outcomes for patients prone to hyperglycemia caused by steroid therapy.

Chromium supplementation provides dual benefits: it improves glycemic control and reduces pain and reliance on medications. Its favorable safety profile, affordability, and ease of administration suggests that chromium is a valuable addition to existing diabetes and pain management strategies. Future research should endeavor to validate these findings in larger cohorts, assess the long-term effects of chromium supplementation, and explore its applicability to other inflammatory and metabolic disorders.

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