

Improving growth and development in children with growth hormone deficiency through transdermal treatment of acupoints with the tonifying spleen and kidney method in conjunction with growth hormone therapy

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Abstract: This retrospective analysis aimed to evaluate the potential benefits of integrating transdermal acupoint therapy with the tonifying spleen and kidney method alongside growth hormone (GH) treatment for pediatric patients suffering from growth hormone deficiency (GHD). Clinical data of 115 pediatric patients with GHD were retrospectively analyzed. Patients were categorized into two distinct groups for the analysis: the conventional GH treatment group (n=62) and the combined group of acupoint transdermal therapy alongside GH treatment (n=53). Baseline characteristics, hormone levels, bone mineral density (BMD), physical growth parameters, and adverse events were compared. The baseline characteristics of the two groups were well-matched. After one year of treatment, the combined group showed significantly lower levels of insulin-like growth factor-1 ($P<0.001$), testosterone ($P<0.001$), estrogen ($P<0.001$), thyroid-stimulating hormone ($P<0.001$), insulin-like growth factor binding protein-3 ($P=0.009$) and free thyroxine ($P<0.001$) compared to the conventional group. The transdermal treatment group demonstrated significantly higher BMD at multiple sites ($P<0.05$) and improved physical growth parameters ($P<0.05$) compared to the conventional group. Furthermore, the transdermal treatment was not linked to a higher occurrence of adverse incidents and showed significant correlations with various growth and development indexes ($P<0.05$). Combined therapy showed promising effects on endocrine function and physical growth.

Keywords: Growth hormone deficiency, transdermal acupoint therapy, bone mineral density, physical growth parameters, pediatric endocrinology.

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INTRODUCTION

Growth hormone deficiency (GHD) in children is characterized by inadequate production or secretion of growth hormone, critical for growth, development and metabolism (Aguar-Oliveira and Bartke, 2019; Johannsson and Ragnarsson, 2021; Richmond and Rogol, 2008). This deficiency impacts physical growth, skeletal development, body composition and metabolic functions (Akinola *et al.*, 2022; Pollock and Cohen, 2021; Tavares and Collett-Solberg, 2021). Beyond short stature, GHD can delay skeletal maturation, reduce bone mineral density (BMD), impair muscle development and alter lipid and carbohydrate metabolism (Tritos, 2021; Oi-Yo *et al.*, 2024; Wexler *et al.*, 2023). Psychological well-being may also be affected, influencing mood, cognitive function and social interactions (Yuen *et al.*, 2023; Boguszewski, 2021). Comprehensive management strategies are needed to address these multifaceted implications (Kgosidialwa *et al.*, 2019).

The standard treatment for GHD involves the

administration of recombinant human growth hormone (rhGH) to stimulate linear growth and development (van Bunderen and Olsson, 2021). By supplementing exogenous growth hormone, healthcare practitioners seek to emulate the physiological impacts of endogenous growth hormone, thereby promoting bone growth, stimulating the development of tissues and organs and contributing to the achievement of an optimal adult stature (Hage *et al.*, 2021; Lin *et al.*, 2022). In addition to its role in promoting linear growth, growth hormone therapy may also have broader impacts on composition of the body, muscle mass, lipid metabolism and bone health, thus addressing the multi-faceted impact of GHD on children's overall health and well-being (List *et al.*, 2021). The long-term benefits of growth hormone therapy extend beyond immediate gains in height and also encompass potential improvements in bone mineral density, metabolic parameters and overall quality of life (Wydra *et al.*, 2023). Furthermore, growth hormone therapy is often initiated during childhood with the goal of supporting not only physical growth but also optimizing eventual adult height and potentially mitigating the long-term health implications of GHD (Mameli *et al.*, 2023).

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However, there is growing interest in exploring complementary and alternative treatments to enhance the efficacy of conventional growth hormone therapy. One such approach is the transdermal treatment of acupoints with the tonifying spleen and kidney method, a traditional Chinese medicine practice which seeks to promote harmonious development and progression through the stimulation of specific acupoints and the nourishment of essential organ systems (Min *et al.*, 2023; You *et al.*, 2019). The combination of acupoint transdermal therapy with growth hormone treatment represents a novel and integrative approach to address the complex needs of children with GHD (Lu *et al.*, 2021; Luo *et al.*, 2023). The rationale behind this combined therapy lies in the potential synergistic effects of traditional Chinese medicine principles and modern endocrine interventions, with the aim of optimizing growth hormone function, enhancing endocrine regulation and promoting skeletal and physical development (Liu *et al.*, 2022; Ijiri *et al.*, 2023; Jun *et al.*, 2019).

In this context, the present study aims to retrospectively analyze the clinical data of pediatric patients with GHD who received either conventional growth hormone treatment or combined therapy involving acupoint transdermal treatment with the tonifying spleen and kidney method alongside growth hormone treatment. Understanding the potential benefits and outcomes of this integrative treatment approach is of paramount importance in optimizing the care and management of children with GHD. By elucidating the potential synergistic effects of acupoint transdermal therapy with growth hormone treatment, the research aims to participate important perspectives on the changing field of pediatric endocrinology and personalized medicine.

MATERIALS AND METHODS

Patient demographics

This research performed a retrospective assessment of the clinical information of 115 individuals diagnosed with GHD who were received care at our hospital between January 2021 and December 2023. Based on the different treatment methods, the patients were separated into the growth hormone treatment group (referred to as the conventional group, n=62) and the combined group of acupoint transdermal therapy for invigorating the spleen and nourishing the kidney along with growth hormone treatment (referred to as the combined group, n=53). The conventional group included 32 males and 30 females with a mean age at 12.53±1.24 years, while the combined group consisted of 28 males and 25 females with an average age of 12.24±1.54 years.

Inclusion and exclusion criteria

Inclusion Criteria: Children diagnosed with GHD as per standard clinical and laboratory criteria¹; Participants who completed the specified treatment duration as per the study protocol.

Exclusion Criteria: Participants whose medical records and follow-up data were incomplete, including lacking critical information necessary for the study analytical evaluation; Participants with a diagnosis of circumstances other than GHD that may significantly impact growth and development, such as chromosomal abnormalities or chronic systemic diseases; Participants who were concurrently receiving treatments or medications that could potentially affect growth and development.

Treatment methods

Conventional Group: Patients were administered rhGH injection (imported drug registration standard JS20020015 from Danish Novo Nordisk Company) subcutaneously once daily for a duration of 52 weeks.

Combined Group: In addition to the conventional treatment, acupoint transdermal therapy for strengthening the spleen and tonifying the kidney was applied. The prescription for supporting the spleen and replenishing the kidney included 30g of coix seed, fried hyacinth bean 30g, poria 15g, Chinese yam 15g, lotus seed 15g, white peony root 15g, white atractylodes rhizome 15g, psoralea fruit 15g, 10g of tangerine peel and baical skullcap root 6g. The ingredients were mixed and ground uniformly and a dose of 5-10g of the powder was taken each time, mixed with honey and rice vinegar, then formed into pills. These pills were applied on acupoints such as bilateral kidney shu points, fixed with adhesive tape, and left in place. The treatment involves ultrasound-mediated drug delivery using the MC-TD-01 device from Shenyang Meichen Medical Equipment Co., Ltd. The treatment duration is 15 minutes per session, once a day. This was considered one course of treatment lasting 10 days.

Data collection

Eligible participants' medical records were reviewed retrospectively to gather pertinent information, involving basic characteristics, hormone levels, bone mineral density (BMD), physical growth parameters, and adverse events. Data extraction was performed by trained personnel to ensure accuracy and reliability.

ETHICAL APPROVAL

This study was approved by the Ethics Committee of Zhenhai District Hospital of Chinese Medicine (22-ZDCM-EC-03).

STATISTICAL ANALYSIS

The Statistical Package for Social Sciences (SPSS) version 25.0 software (IBM, Armonk, NY, USA) was used to analyze the data. For categorical information, the results are presented as [n (%)], while distributed normally continuous information are expressed as mean (x±s). For distributed non-normally information,

statistical analysis was conducted after transforming the variables to achieve normal distribution, and t-tests were performed. Paired t-tests or non-parametric tests were applied to examine changes in hormone levels, BMD and physical growth parameters within each group.

Independent t-tests or non-parametric tests were applied to compare outcome measures between the conventional and combination groups. Spearman Correlation analyses were conducted to assess associations between growth and development indexes and the transdermal treatment of acupoints with the tonifying spleen and kidney method in conjunction with growth hormone therapy. The choice of non-parametric tests was based on the distribution characteristics of the data, ensuring robust and reliable statistical analysis.

RESULTS

Baseline Characteristics

The baseline characteristics of the participants in the two groups, the conventional group and the combination group, were compared to assess the effectiveness of the interventions (table I). There were no statistically significant differences in age between the two groups ($p=0.274$), body weight ($p=0.417$), height ($p=0.328$), gender distribution ($p>0.05$), baseline hormone levels including IGF-1 ($p=0.12$), insulin ($p=0.683$), testosterone ($p=0.564$), physical activity ($p=0.166$), and dietary intake ($p=0.14$). These findings suggest that the two groups were comparable at baseline, supporting the comparability of the groups for the intervention study.

Hormone levels

Firstly, the hormone levels of the two groups were studied, and the findings demonstrated that there was a significant variation in hormone levels between the two groups after 1 year of treatment ($p<0.05$) (table II). Significantly lower levels of IGF-1 ($231.76\pm 18.97\text{ng/mL}$ vs. $255.45\pm 20.22\text{ng/mL}$; $p<0.001$) were observed in the combination group, testosterone ($455.36\pm 18.44\text{ng/dL}$ vs. $431.62\pm 20.54\text{ng/dL}$; $p<0.001$), estrogen ($67.58\pm 5.13\text{pg/mL}$ vs. $61.27\pm 5.34\text{pg/mL}$; $p<0.001$), thyroid-stimulating hormone ($2.04\pm 0.24\mu\text{IU/mL}$ vs. $2.34\pm 0.37\mu\text{IU/mL}$; $p<0.001$), and free thyroxine ($1.17\pm 0.12\text{ng/dL}$ vs. $1.57\pm 0.11\text{ng/dL}$; $p<0.001$) in comparison to the conventional group. No significant variation was observed in the levels of insulin-like growth factor binding protein-3 between the two groups ($3186.35\pm 60.23\text{ng/mL}$ in the combination group vs. $3221.33\pm 81.33\text{ng/mL}$ in the conventional group; $p=0.09$). The findings indicate that the combined treatment resulted in notable alterations in hormone levels compared to the conventional treatment, indicating its potential for modulating endocrine function.

Bone mineral density (BMD)

To investigate the impact of treatment methods on bone mineral density (BMD) of patients, a relevant study was

conducted (fig. I). The study detected a significant difference in BMD from the growth hormone treatment group to the growth hormone acupoint transdermal treatment group following 1 year of therapy and the difference was statistically significant. The Transdermal Treatment group demonstrated significantly higher BMD at the lumbar spine ($1.19\pm 0.07\text{g/cm}^2$ vs. $1.15\pm 0.08\text{g/cm}^2$; $p=0.005$), femoral neck ($1.12\pm 0.06\text{g/cm}^2$ vs. $1.05\pm 0.07\text{g/cm}^2$; $p<0.001$) and total body ($1.27\pm 0.08\text{g/cm}^2$ vs. $1.18\pm 0.09\text{g/cm}^2$; $p<0.001$) compared to the Growth Hormone Treatment Group. These findings suggest that the transdermal treatment of acupoints with growth hormone has a more favorable impact on bone mineral density at multiple sites compared to the conventional growth hormone treatment, highlighting its potential as a targeted intervention for improving bone health.

Physical growth parameters

The physical growth parameters of patients at the Growth Hormone Treatment Group and the Transdermal Treatment of Acupoints with Growth Hormone Group were compared, revealing significant differences (table III). The Transdermal Treatment group exhibited a significantly higher annual growth rate ($8.83\pm 1.22\text{cm/year}$ vs. $8.12\pm 1.11\text{cm/year}$; $p=0.001$), lower Tanner stage at puberty onset (2.05 ± 0.36 vs. 2.56 ± 0.25 ; $p<0.001$), greater sitting height ($80.54\pm 3.13\text{cm}$ vs. $78.37\pm 3.26\text{cm}$; $p<0.001$), longer arm span ($168.89\pm 5.87\text{cm}$ vs. $165.63\pm 6.14\text{cm}$; $p=0.004$), and longer leg length ($89.53\pm 3.86\text{cm}$ vs. $87.24\pm 4.12\text{cm}$; $p=0.003$) compared to the Growth Hormone Treatment Group. Nevertheless, there was no significant disparity was observed in bone age ($p=0.134$) and dental age ($p=0.601$) between the two groups. These results indicate that the transdermal treatment of acupoints with growth hormone was associated with significantly improved growth parameters, indicating its potential as an effective intervention for promoting physical growth and maturation.

Adverse events

This research assessed the occurrence of adverse events between the two groups, and the outcomes indicated that the occurrence of adverse events such as injection site reactions (8.06% vs. 5.66% ; $p=0.891$), gastrointestinal upset (6.45% vs. 5.66% ; $p>0.05$), skin irritation at acupoints (0% vs. 3.77% ; $p=0.408$), fatigue (6.45% vs. 7.55% ; $p>0.05$), headache (4.84% vs. 3.77% ; $p>0.05$), joint pain (6.45% vs. 3.77% ; $p=0.823$), and mood changes (6.45% vs. 5.66% ; $p>0.05$) did not significantly differ between the two groups (table IV). The outcomes revealed that the transdermal treatment of acupoints with growth hormone was not associated with a greater frequency of adverse events relative to conventional growth hormone treatment, indicating its potential as a well-tolerated intervention.

Table 1: Baseline characteristics of the participants in the two groups

Parameter	Conventional group (n=62)	Combination group (n=53)	t/X ²	p Value
Age (years)	12.53 ± 1.24	12.24 ± 1.54	1.1	0.274
Body Weight (kg)	45.62 ± 3.58	46.22 ± 4.17	0.815	0.417
Height (cm)	150.37 ± 6.24	151.47 ± 5.83	0.982	0.328
Gender (M/F)	32 / 30	28/ 25	0	>0.05
Baseline Hormone Levels				
- IGF-1 (ng/mL)	254.44 ± 30.86	245.73 ± 28.67	1.567	0.12
- Insulin (μU/mL)	9.99 ± 1.12	10.08 ± 1.24	0.41	0.683
-Testosterone (ng/dL)	450.87 ± 40.28	455.13 ± 38.59	0.578	0.564
Baseline Physical Activity (hours/week)	7.21 ± 1.57	7.59 ± 1.37	1.396	0.166
Baseline Dietary Intake (kcal/day)	2201.36 ± 200.37	2254.31 ± 181.43	1.487	0.14

Table 2: Hormone Levels after one year of treatment

Parameter	Conventional group (n=62)	Combination group (n=53)	t	p Value
IGF-1 (ng/mL)	255.45 ± 20.22	231.76 ± 18.97	6.474	p<0.001
Testosterone (ng/dL)	431.62 ± 20.54	455.36 ± 18.44	6.53	p<0.001
Estrogen (pg/mL)	61.27 ± 5.34	67.58 ± 5.13	6.46	p<0.001
Insulin-like Growth Factor Binding Protein-3 (ng/mL)	3221.33 ± 81.33	3186.35 ± 60.23	2.643	0.009
Thyroid-stimulating Hormone (μIU/mL)	2.34 ± 0.37	2.04 ± 0.24	5.434	p<0.001
Free Thyroxine (ng/dL)	1.57 ± 0.11	1.17 ± 0.12	18.079	p<0.001

Table 3: Physical Growth Parameters of participants in both groups

Parameter	Conventional group (n=62)	Combination group (n=53)	t	p Value
Annual Growth Rate (cm/year)	8.12 ± 1.11	8.83 ± 1.22	3.262	0.001
Puberty Onset (Tanner stage)	2.56 ± 0.25	2.05 ± 0.36	8.769	p<0.001
Sitting Height (cm)	78.37 ± 3.26	80.54 ± 3.13	3.64	p<0.001
Arm Span (cm)	165.63 ± 6.14	168.89 ± 5.87	2.914	0.004
Leg Length (cm)	87.24 ± 4.12	89.53 ± 3.86	3.068	0.003
Bone Age (years)	12.76 ± 0.88	12.53 ± 0.75	1.508	0.134
Dental Age (years)	12.94 ± 0.76	12.87 ± 0.66	0.525	0.601

Table 4: Adverse Events in the two groups [n (%)]

Adverse event	Conventional group (n=62)	Combination group (n=53)	X ²	p Value
Injection Site Reactions	5 (8.06%)	3 (5.66%)	0.019	0.891
Gastrointestinal Upset	4 (6.45%)	3 (5.66%)	0	>0.05
Skin Irritation at Acupoints	0 (0%)	2 (3.77%)	0.685	0.408
Fatigue	4 (6.45%)	4 (7.55%)	0	>0.05
Headache	3 (4.84%)	2 (3.77%)	0	>0.05
Joint Pain	4 (6.45%)	2 (3.77%)	0.05	0.823
Mood Changes	4 (6.45%)	3 (5.66%)	0	>0.05

Table 5: Correlation analysis between growth and development indexes and acupoint transdermal treatment of Jianpi-Bushen decoction combined with growth hormone therapy

	r	R ²	P
Lumbar Spine BMD (g/cm ²)	0.258	0.067	0.005
Femoral Neck BMD (g/cm ²)	0.446	0.199	p < 0.001
Total Body BMD (g/cm ²)	0.461	0.213	p < 0.001
Annual Growth Rate (cm/year)	0.295	0.087	0.001
Puberty Onset (Tanner stage)	-0.647	0.418	p < 0.001
Sitting Height (cm)	0.323	0.104	p < 0.001
Arm Span (cm)	0.263	0.069	0.004
Leg Length (cm)	0.276	0.076	0.003
Bone Age (years)	-0.139	0.019	0.139
Dental Age (years)	-0.049	0.002	0.605

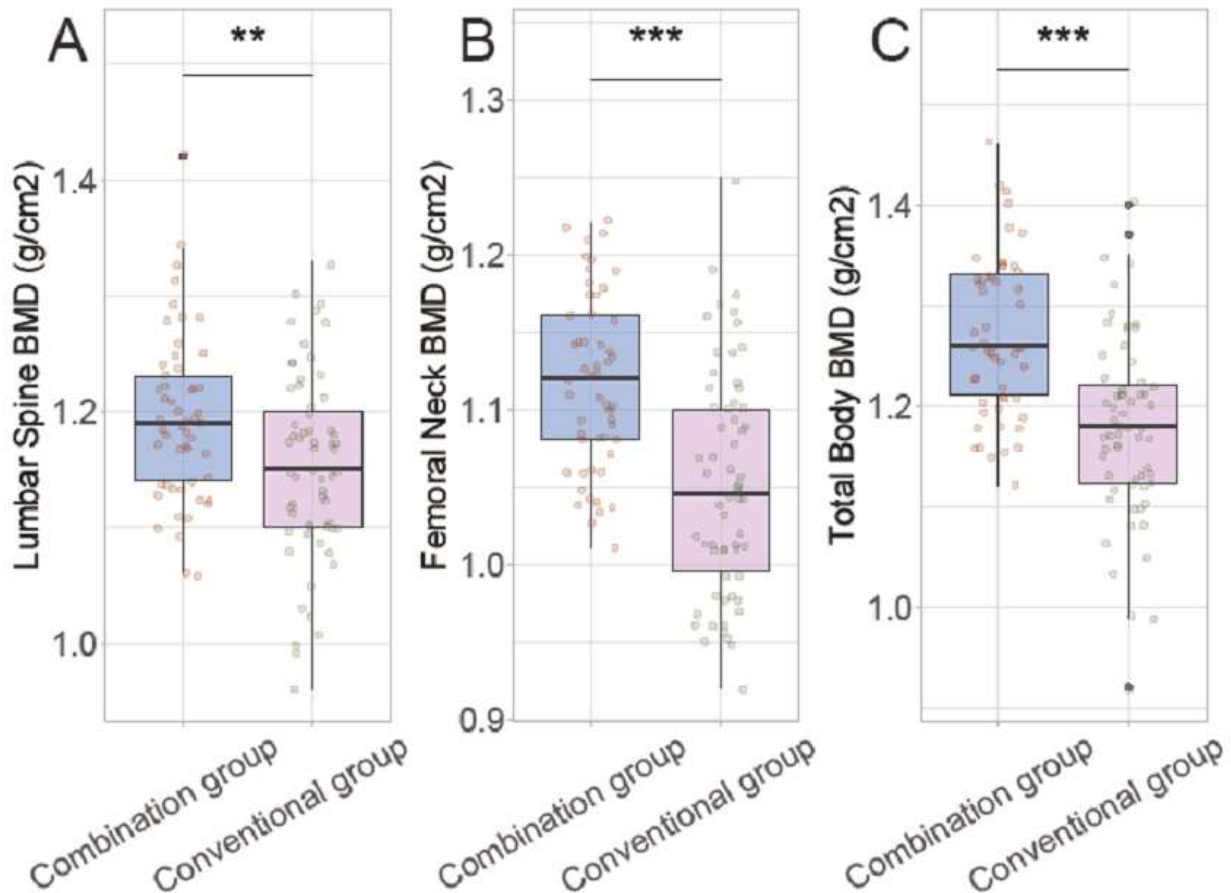


Fig. 1: Bone Mineral Density (BMD) after one year of treatment. A: Lumbar Spine BMD (g/cm²); B: Femoral Neck BMD (g/cm²); C: Total Body BMD (g/cm²). **: $P < 0.01$; ***: $P < 0.001$.

Correlation analysis

The correlation analysis between growth and development indexes and acupoint transdermal treatment of Jianpi-Bushen decoction combined with growth hormone therapy revealed several significant associations (table V). The indexes including lumbar spine BMD ($r=0.258$, $p=0.005$), femoral neck BMD ($r=0.446$, $p<0.001$), total body BMD ($r=0.461$, $p<0.001$), annual growth rate ($r=0.295$, $p=0.001$), sitting height ($r=0.323$, $p<0.001$), arm span ($r=0.263$, $p=0.004$) and leg length ($r=0.276$, $p=0.003$) exhibited positive correlations with the treatment, indicating their favorable response to the intervention. Conversely, puberty onset (Tanner stage) showed a negative correlation ($r=-0.647$, $p<0.001$) with the treatment. However, no significant correlations were observed between the treatment and bone age ($r=-0.139$, $p=0.139$) or dental age ($r=-0.049$, $p=0.605$).

These findings suggest that the acupoint transdermal treatment of Jianpi-Bushen decoction combined with growth hormone therapy was associated with significant correlations with various growth and development indexes, indicating its potential influence on these parameters.

DISCUSSION

The findings of this retrospective analysis provided valuable insights into the potential benefits of integrating transdermal treatment of acupoints with the tonifying spleen and kidney method alongside growth hormone therapy for children with GHD. The results indicated that the combined therapy had notable effects on hormone levels, bone mineral density (BMD), physical growth parameters and adverse events compared to conventional growth hormone treatment. These findings have significant implications for the management of GHD and provide a basis for further exploration of integrative approaches in pediatric endocrinology.

The basic characteristics of the participants in the conventional group and the combination group were well-matched, supporting the comparability of the groups for the intervention study. Notably, the combination group exhibited significantly lower standards of insulin-like growth factor-1 (IGF-1), testosterone, estrogen, thyroid-stimulating hormone and free thyroxine compared to the conventional group after one year of treatment. A similar point was mentioned in the study by Haj-Ahmad LM *et al.* (2023). This suggests that the transdermal treatment of

acupoints with the tonifying spleen and kidney method in conjunction with growth hormone therapy had a notable impact on endocrine function, leading to alterations in hormone levels. These findings are consistent with the traditional Chinese medicine principles underlying the tonifying spleen and kidney method, which aims to nourish essential organ systems and promote harmonious growth and development (Ijiri *et al.*, 2023). The potential synergistic effects of traditional Chinese medicine principles and modern endocrine interventions highlight the integrative nature of the combined therapy, offering a holistic approach to addressing the complex needs of children with GHD.

In terms of bone health, the transdermal treatment group demonstrated significantly higher BMD at the lumbar spine, femoral neck and body as a whole in comparison to the conventional growth hormone treatment group after one year of treatment. These results are consistent with findings by Lu, Junjie, *et al.* (2022), who observed improvements in BMD with the use of traditional Chinese medicine in conjunction with growth hormone therapy. The significant improvements in BMD observed in the transdermal treatment group suggest that the acupoint therapy with the tonifying spleen and kidney method may have influenced bone health through several mechanisms. TCM principles posit that the spleen and kidney are vital for nutrient absorption and hormonal balance. By strengthening these organs, the therapy enhances calcium absorption, regulates hormones like TSH and thyroid hormones, improves local circulation, reduces inflammation, and stimulates osteoblast activity, all of which contribute to better bone mineralization and density.

Furthermore, the physical growth parameters of the transdermal treatment group showed significant improvements in comparison to those of the conventional growth hormone treatment group. The transdermal treatment group exhibited a significantly higher annual growth rate, lower Tanner stage at puberty onset, higher sitting height, longer arm span and longer leg length compared to the growth hormone treatment group. These findings are supported by the work of Peng *et al.* (2022), who found that the integration of traditional Chinese medicine with growth hormone therapy led to enhanced physical growth parameters. The traditional Chinese medicine approach of the tonifying spleen and kidney method may contribute to the observed enhancements in physical growth parameters, aligning with the holistic principles of promoting harmonious growth and development.

Importantly, the analysis of adverse events revealed that the transdermal treatment of acupoints with growth hormone was not associated with an increased occurrence of adverse events in comparison to conventional growth hormone treatment. This is consistent with the safety

profile reported by Garner *et al.* (2024), indicating that the combined treatment is well-tolerated, with no significant increase in the occurrence of adverse events such as injection site reactions, gastrointestinal upset, skin irritation at acupoints, fatigue, headache, joint pain and mood changes. The favorable safety profile of the combined treatment is a crucial consideration when treating pediatric patients with GHD, as it underscores the potential for integrating complementary and alternative treatments without compromising safety and tolerability.

The correlation analysis between growth and development indexes and the acupoint transdermal treatment of the tonifying spleen and kidney method in conjunction with growth hormone therapy revealed significant associations. The positive correlations observed between the treatment and indexes such as BMD of the femoral neck, BMD of the lumbar spine and BMD of the total body, annual growth rate, arm span, sitting height and leg length highlight the potential influence of the combined therapy on these parameters. These findings are in agreement with the work of Zhou *et al.* (2020), who also observed significant correlations between growth and development indexes and the use of traditional Chinese medicine combined with growth hormone therapy. Conversely, the negative correlation observed with puberty onset (Tanner stage) suggests potential modulation of pubertal maturation by the combined therapy. These significant correlations further support the potential synergistic effects of traditional Chinese medicine principles and modern endocrine interventions, emphasizing the holistic and integrative nature of the combined approach in impacting multiple aspects of development and growth in GHD-affected children.

Overall, the findings of this retrospective analysis provide compelling evidence for the potential benefits of integrating the transdermal treatment of acupoints with the tonifying spleen and kidney method alongside growth hormone treatment in children diagnosed with GHD. The findings highlight the multifaceted impact of the combined therapy on endocrine function, bone health, physical growth parameters, and safety profile. These findings contribute valuable insights to the evolving landscape of pediatric endocrinology and personalized medicine, underscoring the potential for synergistic effects between traditional Chinese medicine practices and modern endocrine interventions in addressing the complex needs among GHD-affected children.

The limitations of this research should be acknowledged, including the retrospective nature of the study, the relatively small number of participants, and the single-center setting. Future research efforts should aim to conduct prospective, multicenter studies with larger cohorts to further validate the findings and elucidate the mechanisms underlying the observed effects of the

combined therapy. Additionally, long-term follow-up researches are required to evaluate the sustained impact of the combined treatment on growth, development and overall health outcomes in children with GHD. Furthermore, mechanistic studies investigating the interplay between traditional Chinese medicine principles and growth hormone pathways would offer important perspectives on the underlying mechanisms of the observed effects, guiding the development of targeted and personalized treatment approaches for children with GHD.

CONCLUSION

In conclusion, the present study provides compelling evidence for the potential benefits of integrating the transdermal treatment of acupoints with the tonifying spleen and kidney method alongside growth hormone therapy in children with GHD. The observed effects on endocrine function, bone health, physical growth parameters, and safety profile underscore the potential for synergistic effects between traditional Chinese medicine practices and modern endocrine interventions. These findings contribute to the evolving landscape of pediatric endocrinology and personalized medicine, emphasizing the importance of integrative and holistic approaches in optimizing the care and management of children with GHD.

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