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Examination of Empathy Skills of Adults Diagnosed With Chiari Malformation Type-I

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ABSTRACT

Objective: Empathy, commonly defined as the capacity to understand and share the emotions and perspectives of others, is a fundamental component of social cognition. The present study sought to examine and compare the empathy skills of adults diagnosed with Chiari Malformation Type-I with those of neurologically healthy individuals.

Methods: The study sample consisted of 31 individuals (16 females, 15 males) diagnosed with Chiari Malformation Type-I and 30 healthy controls (15 females, 15 males). Empathy levels were measured using the Cambridge Behavior Scale, a validated instrument assessing four subdimensions: cognitive empathy, emotional response, social competence, and empathic concern. Data were analyzed using a one-way ANOVA to compare group differences. Ethical approval was obtained from the institutional ethics committee (Decision No: 2023-03/24), and written informed consent was provided by all participants.

Results: No statistically significant differences were observed between the groups in total empathy, cognitive empathy, or social competence scores. In contrast, individuals with Chiari Malformation Type-I exhibited significantly lower scores in emotional response and empathic concern ($p < 0.05$). Gender was also found to exert a significant effect on empathy, with female participants demonstrating higher scores in certain subdimensions.

Conclusion: The findings suggest that emotional aspects of empathy may be compromised in individuals with Chiari Malformation Type-I, highlighting the need for psychosocial interventions in this clinical group. Moreover, future research should further explore the contribution of cerebellar structures and mirror neurons to the modulation of empathic processes.

Keywords: Chiari Malformation Type-I, cognitive empathy, emotional response, social competence, empathic concern.

Chiari Malformasyonu Tip-I Tanılı Yetişkinlerin Empati Yeteneklerinin İncelenmesi

Araştırma Makalesi

Süreç

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ÖZ

Amaç: Empati, başkalarının duygularını anlama ve olaylara onların bakış açısından bakma yeteneğidir. Bu çalışma, Chiari Malformasyonu Tip-I tanısı almış yetişkinlerin empati becerilerini sağlıklı bireylerle karşılaştırmayı amaçlamıştır.

Yöntemler: Çalışmaya Chiari Malformasyonu Tip-I tanısı almış 31 birey (16 kadın, 15 erkek) ve 30 sağlıklı kontrol (15 kadın, 15 erkek) dahil edilmiştir. Katılımcıların empati düzeyleri, bilişsel empati, duygusal tepki, sosyal yeterlilik ve empatik ilgi olmak üzere dört alt boyutu değerlendiren Cambridge Davranış Ölçeği kullanılarak değerlendirilmiştir. Veriler tek yönlü ANOVA kullanılarak analiz edilmiştir. Tüm katılımcılardan etik kurul onayı (Karar No: 2023-03/24) ve yazılı bilgilendirilmiş onam alınmıştır.

Bulgular: Gruplar arasında toplam empati, bilişsel empati ve sosyal yeterlilik puanları açısından istatistiksel olarak anlamlı bir fark bulunmamıştır. Bununla birlikte, Chiari Malformasyonu Tip-I olan bireylerin duygusal tepki ve empatik kaygı puanları anlamlı derecede düşüktü ($p < 0,05$). Cinsiyetin empati üzerinde anlamlı bir etkisi olduğu ve kadınların belirli alt boyutlarda daha yüksek puanlar gösterdiği bulundu.

Sonuç: Bulgular, Chiari Malformasyonu Tip-I olan bireylerde empatinin duygusal yönlerinin etkilenebileceğini göstermektedir. Bulgular, bu klinik grupta psikososyal müdahalelerin önemini vurgulamaktadır. Gelecekteki çalışmalar, serebellar yapıların ve ayna nöronların empatik süreçlerin düzenlenmesindeki rolünü daha fazla araştırmalıdır.

***Anahtar Kelimeler*:** Chiari Malformasyonu Tip-I, bilişsel empati, duygusal tepki, sosyal yeterlilik, empatik kaygı.
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Introduction

Chiari Malformation (CM) is a congenital anomaly characterized by the displacement of the cerebellar tonsils through the foramen magnum into the spinal canal.[1] First described by Hans Chiari in 1891, this condition presents with symptoms such as headache, balance disorders, muscle weakness, and emotional dysfunctions.[2] Among the four clinically classified types, Type I is the most common and typically exhibits a milder course. In this type, the cerebellar tonsils are displaced 3-5 mm or more below the foramen.[3]

The cerebellum is known to play a role not only in motor coordination but also in cognitive and emotional processes.[4] It has been suggested that Chiari Malformation Type-I may lead to cognitive impairments and emotional dysregulation, particularly due to pressure on the cerebellar tonsils.[5] Although some studies suggest empathy may be affected in this condition, research on this topic is limited.[6] For instance, Özüm et al. (2022) reported lower performance in executive functions and a higher prevalence of psychiatric disorders in individuals with Chiari Malformation Type-I compared to healthy controls.[7]

Recent advances have reinforced the cerebellum's involvement in affective and social–cognitive processing rather than being limited to motor control. For instance, volumetric and microstructural variations in specific cerebellar regions, such as the right Crus II, have been positively associated with trait empathy measured via IRI in healthy individuals.[8]

Functional neuroimaging meta-analyses reveal that affective empathy activates areas like the insula, whereas cognitive empathy is linked to mid-cingulate cortex and dorsomedial prefrontal cortex activity—highlighting distinct neural correlates for empathy subdimensions.[9]

In the context of Chiari Malformation Type I, emerging evidence suggests postoperative improvements in emotional and attentional regulation, as assessed by the Cerebellar Neuropsychiatric Rating Scale (CNRS), supporting a reversible cerebellar influence on cognitive–affective function.[10]

Furthermore, recent fMRI research using graph learning approaches has pinpointed empathy-related dynamic interactions among insula, amygdala, and thalamus during empathic states, offering a novel network-level perspective.[11]

Empathy is defined as the ability to understand and share others' feelings, encompassing four sub-dimensions: cognitive empathy, emotional responsiveness, social competence, and empathic concern. Cognitive empathy refers to understanding others' emotions, while emotional responsiveness reflects internal reactions to those emotions. Social competence involves skills in social interactions, and empathic concern denotes a genuine interest in others' emotional states.[12]

Although neurological diseases' effects on empathy are well-documented, studies on rare anomalies like Chiari Malformation Type-I are scarce. Investigating the influence of cerebellar dysfunctions on social cognition and emotional regulation in these individuals could provide valuable insights into neurological and psychological processes. Specifically, exploring the role of the mirror neuron system and its impact on empathy is of particular interest.

This study compared empathy levels between individuals with Chiari Malformation Type-I and healthy controls using the Cambridge Behaviour Scale. Gender differences in empathy sub-dimensions were also analysed. The findings are expected to enhance understanding of empathy abilities in individuals with Chiari Malformation Type-I and support the development of psychological interventions for this group.

This study addresses a gap in the literature concerning empathy in Chiari Malformation Type-I. Furthermore, the results may shed light on the cerebellum's role in neuropsychological processes, providing both theoretical and practical implications.

Based on the background outlined above, the present study aims to investigate whether adults diagnosed with Chiari Malformation Type-I show differences in empathy skills compared to healthy controls. Specifically, the following research questions were addressed:

1. Do individuals with Chiari Malformation Type-I differ from healthy individuals in overall empathy levels and its subdimensions (cognitive empathy, emotional response, social skill, empathic concern)?
2. Does gender have a significant impact on empathy scores in individuals with or without Chiari Malformation Type-I?

In line with these questions, the following hypotheses were formulated:

H1: Individuals diagnosed with Chiari Malformation Type-I will have significantly lower scores in emotional response and empathic concern compared to healthy controls.

H2: There will be no significant difference in total empathy, cognitive empathy, or social skill scores between the two groups.

H3: Female participants will score significantly higher than males in cognitive empathy and empathic concern subdimensions.

Materials And Methods

Working Groups

The study included 31 individuals diagnosed with Chiari Malformation Type-I and 30 healthy individuals selected as the control group. The case group consisted of 16 females and 15 males, while the control group was equally distributed of 15 females and 15 males. Participants were selected according to the criteria of not having any neurological or psychiatric diagnosis. Informed consent was obtained from all participants before the study and ethics committee approval was obtained.

The study was designed to test three specific hypotheses regarding group differences and gender-related effects on empathy and its subdimensions.

Data Collection Tools

Cambridge Behavior Scale

In the study, the Cambridge Behavior Scale, consisting of 60 items, was used to measure empathy levels. Leyla Baysan Arabacı and Emre Bora adapted the scale into Turkish.[13] This reliable and valid scale assesses empathy in four sub-dimensions: cognitive empathy, emotional response, social competence, and empathic interest. The scale enables separate scoring for each sub-dimension and the total empathy score calculation.

Application

For this thesis study, the necessary permissions were obtained from the faculty ethics committee (Decision No: 2023- 03/24) and the Chief Physician of Sivas Cumhuriyet University Health Services Application and Research Hospital, and ethical rules were adhered to during the study. Firstly, a personal information form was filled out. In this form, there were 7 questions about the participant's name, surname, age, gender, menstruation if female, place of residence, socioeconomic level, and history of neurological and psychiatric diseases. The Cambridge Behaviour Scale was completed individually. Data from the case group were collected in a clinical setting after diagnostic procedures had been completed. The control group was selected from individuals with similar age, gender, and education level and the data collection process was carried out under the same conditions.

Data Analysis

The data obtained were evaluated using statistical analysis software. Participants' total empathy levels and scores in sub-dimensions were analysed with a one-way analysis of variance (ANOVA) to reveal group differences. In addition, subgroup analyses were performed to evaluate gender differences in empathy levels. The statistical significance limit was accepted as $p < 0.05$.

Prior to data collection, a priori power analysis was conducted using G*Power (Version 3.1.9.7) to determine the minimum required sample size. Assuming a medium effect size (f = 0.25), alpha level of 0.05, and power (1-β) of 0.80 for a one-way ANOVA design with two groups, the analysis indicated that a minimum of 52 participants (26 per group) would be sufficient. The final sample of 61 participants exceeded this requirement, suggesting adequate statistical power to detect group differences.

Ethical Approval

The study was conducted with the permission of the ethics committee of the relevant institution. All participants voluntarily participated in the study and their personal information was protected by the principle of confidentiality.

Results

Demographic Information

A total of 61 individuals participated in the study. The mean age of the individuals with Chiari Malformation Type-I in the case group was 38.7 ± 6.4 years, while the mean age of the control group was 37.9 ± 6.1 years. There were 16 females (51.6%) and 15 males (48.4%) in the case group, while 15 females (50%) and 15 males (50%) were equally distributed in the control group. Both groups were homogeneously distributed in terms of age, gender, and Socioeconomic status (Figure 1, Figure 2, Figure 3).

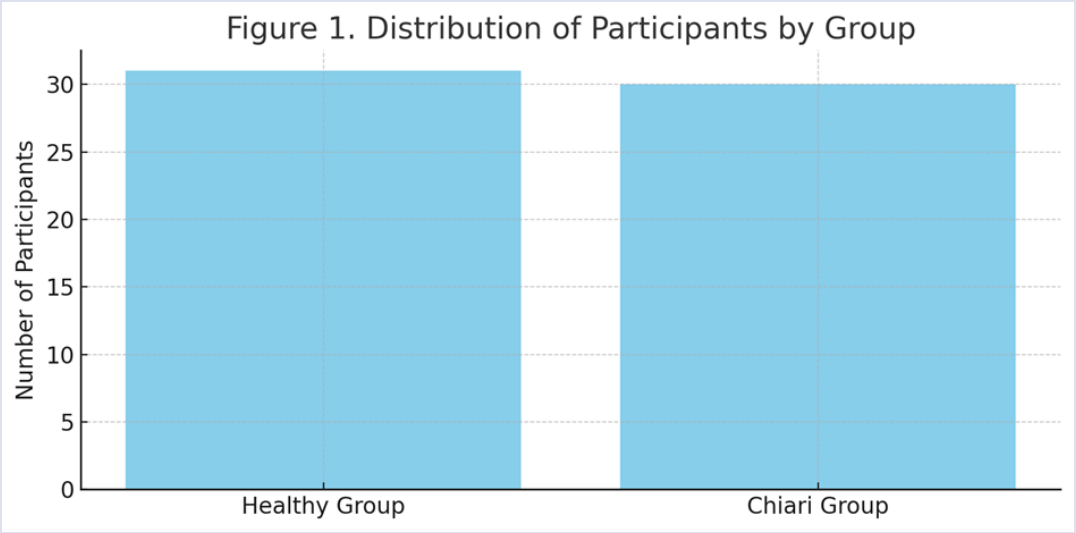


Figure 1. Distribution of Participants by Group

Note: This figure displays the number of participants in the Chiari Malformation Type-I group and the healthy control group.

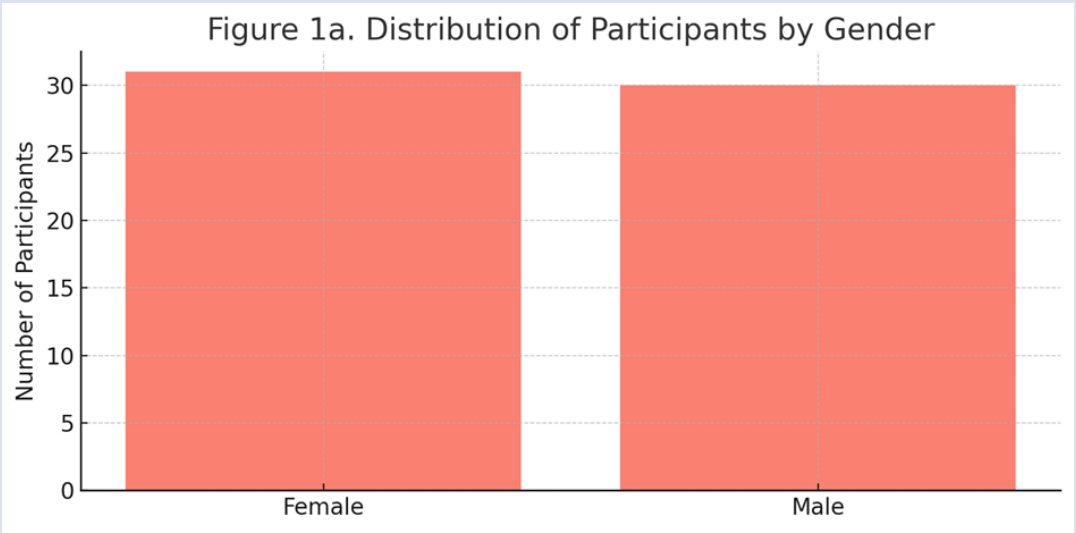


Figure 1a. Distribution of Participants by Gender

Note: This figure shows the gender distribution of participants across both groups.

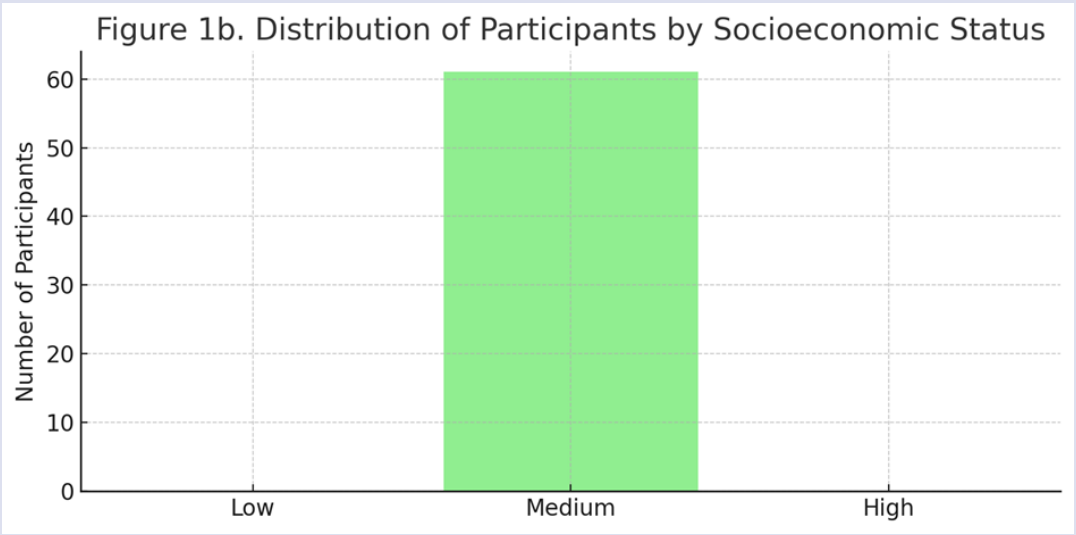


Figure 1b. Distribution of Participants by Socioeconomic Status

Note: While all participants were from the middle socioeconomic level, there were no participants from low or high socioeconomic levels.

Total Empathy Levels

According to the results of the Cambridge Behavior Scale, the mean total empathy score of the individuals diagnosed with Chiari Malformation Type-I was 123.5 ± 15.8, while this value was 127.9 ± 14.7 in the control group. There was no statistically significant difference between the two groups in total empathy levels (p= 0.21).

Subdimension Analyses

Empathy subdimensions were analyzed to examine the effects of Chiari Malformation Type-I. The findings are summarized as follows:

1. Cognitive Empathy: The mean cognitive empathy score of the case group was 34.2 ± 5.3, while that of the control group was 35.4 ± 4.8. This difference was not statistically significant (p = 0.18).
2. Emotional Response: The mean emotional response score of the case group was 31.8 ± 6.7 and that of the control group was 36.5 ± 5.9. The difference between the two groups was statistically significant (p = 0.03).
3. Social Ability: In terms of social ability scores, the mean of the case group was 28.1 ± 4.5 and the mean of the control group was 29.0 ± 4.3. This difference was not statistically significant (p=0.41).
4. Empathic Interest: The mean empathic interest score of the case group was 29.4 ± 5.2, while that of the control group was 32.8 ± 4.9. This difference was statistically significant (p=0.02), (Figure 2).

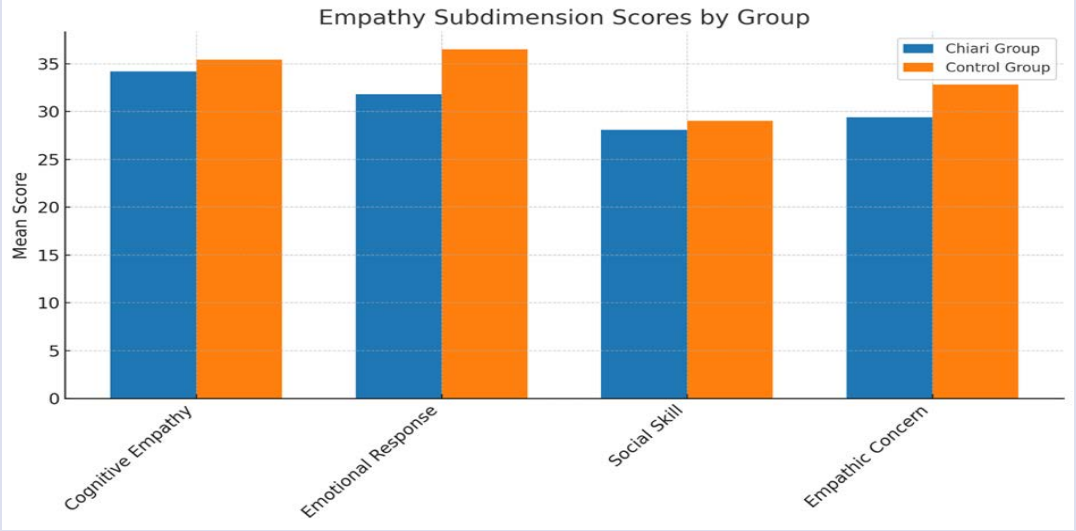


Figure 2. Mean Empathy Subdimension Scores of Chiari Malformation Type-I and Control Groups

Note: This figure presents the mean scores of participants from the Chiari Malformation Type-I group and the healthy control group across four empathy subdimensions: cognitive empathy, emotional response, social skill, and empathic concern. Emotional response and empathic concern showed statistically significant differences between groups ($p < 0.05$), while cognitive empathy and social skill did not.

Impact of Gender Factor

Gender showed a significant effect on empathy sub-dimensions. Female participants had significantly higher scores in cognitive empathy and empathic concern scores than male participants ($p < 0.05$). Gender difference was not found to be significant in terms of emotional response and social ability scores ($p > 0.05$).

Discussion

In this study, the differences between the empathy levels of individuals diagnosed with Chiari Malformation Type-I and healthy individuals were examined. The findings showed that Chiari Malformation Type-I did not make a significant difference in total empathy levels, but it may have significant effects on emotional response and empathic interest, which are sub-dimensions of empathy. Compared to the findings in the literature, these results provide new clues about both the role of the cerebellum on social cognition and how neurological diseases may affect emotional processes.

Total Empathy Levels

No significant difference was found between the total empathy levels of individuals diagnosed with Chiari Malformation Type-I and the total empathy levels of healthy individuals. This result suggests that Chiari Malformation Type-I does not have a limiting effect on overall empathy capacity. In the literature, it is stated that cerebellar dysfunctions may have different degrees of effects on cognitive and emotional functions.[4] However, the reason why this did not affect the overall empathy levels may be that empathy skills are supported by different neurological regions other than the cerebellum.[6]

Subdimension Analyses

It was observed that individuals diagnosed with Chiari Malformation Type-I scored lower on the emotional response and empathic concern subscales compared to healthy individuals. This points to the critical role of the cerebellum in emotional regulation. Such findings support the cerebellum's modulatory role in emotional processing via limbic pathways. The suppression of the cerebellar tonsils in Chiari Malformation Type-I may have negatively affected these regulatory processes, leading to decreases in emotional
response and empathic interest levels.

These findings align with the present study's results—specifically the selective attenuation in emotional response and empathic concern—but extend the discussion by situating Chiari-associated empathy alterations within a broader neural connectivity framework involving cerebellar, insular, and limbic regions.

This finding suggests that Chiari Malformation Type-I mostly affects emotional dimensions and has a limited effect on cognitive processes. In the literature, it is stated that the prefrontal cortex is related to cognitive empathy and the cerebellum plays an indirect role in this process.[12] Therefore, cerebellar dysfunction might be expected to have less pronounced effects in these areas.

The absence of significant differences in cognitive empathy and social competence may indicate that these domains are less susceptible to cerebellar dysfunction or are more resilient due to compensatory mechanisms in cortical networks, particularly in the prefrontal cortex.

This implies that these individuals can still understand others' perspectives and engage socially, despite emotional difficulties.

Such a dissociation between affective and cognitive components of empathy is supported by prior

neurocognitive models, which emphasize the differential neural correlates of these subdomains.

Effect of Gender Factor

Another important finding of the study is the effect of gender on empathy levels. Female participants scored higher on the cognitive empathy and empathic concern subscales than male participants. This is consistent with women's generally higher performance in empathy skills based on biological and social factors.[6] However, the lack of gender differences in the emotional response and social competence subscales suggests that these skills are shaped more by the individual's neurological status.

Comparison with Literature

This study is original research in which empathy skills were evaluated comprehensively for the first time in individuals diagnosed with Chiari Malformation Type-I. In the literature, there are a limited number of studies investigating the effects of cerebellar dysfunctions on social cognition. For example, Longcamp et al. (2003) drew attention to the regulatory role of cerebellar lesions in emotional processes.[15] Sımılary Schmahmann (1996) emphasized that cerebellar cognitive affective syndrome has significant effects on emotional and social skills.[14] This study provides findings that support and extend this literature.

Limitations of the Study and Future Research

This study has some limitations. The number of participants may be limited in terms of making broader generalizations. Also, since the scale used was based only on participants' self-reports, it is difficult to say that emotional processes were objectively measured. In future studies, it is recommended to use neuroimaging techniques and other neuropsychological tests to assess empathy levels. Furthermore, comparing the effects of different types of Chiari Malformation on empathy may contribute to a more comprehensive understanding of this field.

In addition to the aforementioned limitations, the relatively small sample size (n=61) restricts the statistical power and reduces the generalizability of the findings to broader populations.

Moreover, the cross-sectional design of this study precludes causal interpretations regarding the relationship between Chiari Malformation Type-I and alterations in empathy subdimensions.

Future studies should employ larger, more representative samples and consider longitudinal or experimental designs to better understand the directionality and mechanisms underlying the observed associations.

This is especially important for studying subtle neuropsychological changes like empathy, which may shift with neural adaptation over time.

In addition to the limited sample size and reliance on self-report measures, the absence of standardized psychiatric screening within the control group constitutes a significant limitation. Although participants were selected based on self-declared mental health history, undiagnosed psychiatric conditions could have influenced empathy scores and confounded group comparisons.

Another limitation concerns the socioeconomic homogeneity of the sample. All participants were from middle-income backgrounds, which limits the representativeness of the findings across broader socioeconomic contexts. Empathy, as a socially shaped construct, may vary with socioeconomic stressors, access to resources, and educational opportunities.

Conclusion And Recommendations

This study evaluated the effects of this neurological condition on social cognitive skills by comparing the empathy levels and empathy sub-dimensions of individuals diagnosed with Chiari Malformation Type-I with healthy individuals. The findings revealed that Chiari Malformation Type-I did not cause a significant difference in total empathy levels, but may have negative effects on emotional response and empathic interest, which are sub-dimensions of empathy. These results point to the cerebellum's role in emotional regulation processes and indicate that Chiari Malformation Type-I may selectively affect individuals' emotional and social functions.

When the gender factor was analyzed, it was observed that women scored higher in cognitive empathy and empathic interest, confirming the influence of biological and social factors on empathic abilities. However, no gender difference was found in emotional response and social competence, suggesting that these areas are more strongly influenced by neurological processes.

This study fills the gap in the literature and provides important information about the effects of Chiari Malformation Type-I on social cognitive skills. The findings provide recommendations for the development of psychological interventions and therapeutic approaches to support the emotional and social functioning of individuals with Chiari Malformation Type-I.

Recommendations

Future studies are recommended to examine the effects of Chiari Malformation Type-I on empathy more comprehensively using neuroimaging techniques and biological measures.

Studies comparing individuals with different neurological and psychiatric conditions may provide a broader perspective on the effects of this condition on social cognition.

The effects of emotional support programs and social cognitive skills training for individuals with Chiari Malformation Type-I should be investigated to improve the quality of life of these individuals.

These results contribute not only to scientific knowledge but also to practical approaches to the daily lives of individuals diagnosed with Chiari Malformation Type-I.

Given the selective impairment in emotional components of empathy, psychosocial support programs tailored for individuals with Chiari Malformation Type-I should prioritize emotion-focused strategies. These may include affective skills training, mindfulness-based interventions, and therapeutic approaches aimed at enhancing emotional awareness and regulation.

In clinical settings, it may also be beneficial to integrate structured counseling protocols that address social-emotional functioning, thereby supporting both patients and their caregivers in navigating interpersonal and psychological challenges.

Follow-up by neurologists, psychologists, and rehabilitation experts may help detect emotional issues early and support holistic care.

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