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CLINICAL PROFILE OF OCULAR MOTILITY PROBLEMS IN CHILDREN AGED 2-15 YEARS, PRESENTING TO REGIONAL INSTITUTE OF OPHTHALMOLOGY, SITAPUR

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ABSTRACT **Introduction:** Ocular motility, the coordination of eyes for tracking objects and maintaining binocular vision, can be disrupted, affecting a child's visual development, academic performance, and quality of life. Understanding the clinical profile of ocular motility problems is crucial for early diagnosis and management. **Objective:** To study clinical profile of ocular motility problems in children aged 2-15 years, presenting to Regional Institute of Ophthalmology, Sitapur. **Materials and method:** A retrospective, prospective hospital based observational study was conducted at Regional Institute of Ophthalmology, Sitapur, India. All patients with ocular motility problems who presented over a 6 years period were evaluated with detailed clinical history and examination. **Results:** A total of 1930 children with ocular motility problems were evaluated. The study population consists of 56.22% male and 43.78% females. Most of the children were in the 11-15 years age group (43.37%) followed by the 6-10 years age group(40.57%). Non-paralytic eye movement disorders (83% of cases) were dominated by esodeviation (38.80%) and exodeviation (28.50%). Paralytic disorders affect 1.14% of patients, primarily with third nerve palsy (7.78%). **Conclusion:** Strabismus affects a significant number of children in pediatric ophthalmology clinics at tertiary care eye hospitals, with most cases being comitant and not requiring tertiary level care. Improving secondary pediatric eye care facilities is needed to alleviate the burden on tertiary referral centers.

KEYWORDS : Strabismus, Esodeviation, Exodeviation, Comitant strabismus, Paralytic strabismus.

INTRODUCTION

Strabismus and amblyopia are common eye-related health issues in India, affecting children from their early years and later leading to vision decline and diminished eye coordination.[1] Despite not being a significant focus in India's national policy for controlling blindness, these conditions have been addressed in pediatric ophthalmology as part of the Vision 2020 effort. Ocular motility, which involves synchronizing eye movements for binocular vision, can be affected by disturbances in this system. Understanding the clinical characteristics of eye movement issues in children aged 2-15 is crucial for diagnosing, intervening, and treating these conditions.[2,3]

Diagnosing and managing ocular motility problems in children is challenging due to their limited communication, varying symptoms, and rapid development. Untreated or inadequately managed issues can lead to long-term visual impairments like amblyopia, diplopia, and reduced depth perception.[4]

Ocular motility disorders in children can range from benign conditions like intermittent exotropia to severe ones like congenital cranial nerve palsies or neurological disorders. Identifying the root cause often requires a comprehensive ophthalmic evaluation, including a detailed history, clinical examination, and specialized diagnostic tests.[5,6]

This clinical profile provides an overview of common ocular motility problems in children aged 2-15 years, their clinical presentation, diagnostic evaluation, and management strategies, aiming to increase awareness, facilitate timely detection, and improve visual outcomes and quality of life.

The study aims to understand the clinical profile of ocular motility problems in children aged 2-15 years, presenting to the Regional Institute of Ophthalmology, Sitapur.

METHODS

The study was conducted at the Paediatrics Ophthalmology clinic of the Regional Institute of Ophthalmology, Sitapur, Uttar Pradesh, India focusing on ocular motility disorders in children aged 2-15 years. The retrospective study was conducted over five years, while the prospective study was conducted over one year. The study included 1608 retrospective children and 322 prospective ones. The study was approved by the Institute's Ethical Committee. Exclusion criteria included children uncooperative for clinical evaluation, history of previous ocular surgery, children with ocular comorbidities, unwilling participants, and mentally challenged patients.

A study was conducted at the Regional Institute of Ophthalmology in Sitapur, India, involving children aged 2-15 years with ocular motility problems. The participants were Indian, and informed consent was obtained. The study involved a comprehensive ocular examination, diagnostic tools, and a medical history. Primary outcomes included the types and frequency of ocular motility disorders, associated conditions like amblyopia, treatment initiated, and follow-up data. Statistical analysis was performed using SPSS version 21.0, with a p-value of 0.05 considered statistically significant.

RESULTS

Total 1930 patients with ocular motility disorders, 1085 (56.22%) were male and 845 (43.78%) female, with a male to female ratio of 1.28. The majority (53.22%) had amblyopia, with 53.02% having it. The majority (24.82%) were emmetropic, with hypermetropia being the most common refractive error. The majority (65.85%) were treated conservatively, with 659 (34.15%) surgically. The majority (n=1601) were non-paralytic, with esodeviation being the most prevalent condition. Paralytic eye movement disorders were identified in 22 patients, with third nerve palsy being the predominant condition. Nystagmus was reported in 307 patients, accounting for 15.91% of the total cohort. The data provides a clear epidemiological profile for further research and clinical management of these disorders.(Table 1)

Table 1: Distribution of patients according to demographic profile, according to presence of amblyopia, according to refractive error and different ocular motility disorders

Parameters	No.	%
Gender		
Male	1085	56.22
Female	845	43.78
Total	1930	100
Age		

2-5 years	310	16.06
6-10 years	783	40.57
11-15 years	837	43.37
Total	1930	100.00
Mean±SD	9.641±3.60	
Amblyopia		
Present	1023	53.01
Absent	907	46.99
Total	1930	100.00
Refractive error		
Emmetropia	479	24.82
Myopia	335	17.36
Hypermetropia	1116	57.82
Total	1930	100
Treatment type		
Conservative	1271	65.85
Surgical	659	34.15
Non-paralytic n=1601 (83%)		
Esodeviation	749	38.80
Exodeviation	550	28.50
Vertical deviation	23	1.19
Convergence insufficiency	279	14.46
Paralytic n=22 (1.14%)		
Third nerve palsy	15	7.78
Sixth nerve palsy	7	0.36
Fourth nerve palsy	0	0
Others		
Nystagmus	307	15.91
Total	1930	100%
Diagnosis		
Esophoria	37	1.92
Esotropia	541	28.03
Intermittent Esotropia	54	2.80
Exophoria	86	4.46
Exotropia	339	17.56
Intermittent Exotropia	125	6.48
Convergence Insufficiency	279	14.46
Accommodative Esotropia	117	6.06
Hypertropia	23	1.19
Third Nerve Palsy	15	0.78
Sixth Nerve Palsy	7	0.36
Nystagmus	307	15.91
Total	1930	100.00

The study reveals that males have a higher prevalence of ocular motility disorders, with esophoria and esotropia being more prevalent in males (62.16% vs 37.84%) and intermittent esotropia in males (62.96% vs 37.04%). Convergence Insufficiency was more prevalent in females (53.41% vs 46.59%), while accommodating esotropia and intermittent exotropia had slight male predominance. Third nerve palsy was more common in females (66.67% vs 33.33%) and sixth nerve palsy in males (71.43% vs 28.57%). (Table 2)

Table 2: Distribution of patients according to different ocular motility disorders in male and female gender.

Diagnosis	Total	Male (n=1085)		Female (n=845)	
		No.	%	No.	%
Esophoria	37	23	62.16	14	37.84
Esotropia	541	306	56.56	235	43.44
Intermittent Esotropia	54	34	62.96	20	37.04
Exophoria	86	53	61.63	33	38.37
Exotropia	339	202	59.59	137	40.41
Intermittent Exotropia	125	62	49.60	63	50.40
Convergence Insufficiency	279	130	46.59	149	53.41
Accommodative Esotropia	117	62	52.99	55	47.01
Hypertropia	23	11	47.83	12	52.17
Third Nerve Palsy	15	5	33.33	10	66.67
Sixth Nerve Palsy	7	5	71.43	2	28.57
Nystagmus	307	192	62.54	115	37.46

The study reveals that ocular motility disorders are prevalent in different age groups, with esophoria being more prevalent in older children (11.81%) and esotropia in younger children (22.92%). Intermittent esotropia is more common in younger children (6-10 years), while convergence insufficiency increases with age (0.72% in 2-5 years). Accommodative esotropia is highest in the 6-10 years age group (64.10%). Hypertropia, Third Nerve Palsy, Sixth Nerve Palsy, and Nystagmus also show varying prevalence across age groups, indicating age-related patterns in these eye conditions. Convergence insufficiency also increases with age, with 0.72% in 2-5 years, 6.81% in 6-10 years, and 92.47% in 11-15 years. (Table 3)

Table 3: Distribution of patients according to different ocular motility disorders in different age groups

Diagnosis	Total	2-5 years (n=310)		6-10 years (n=783)		11-15 years (n-837)	
		No.	%	No.	%	No.	%
Esophoria	37	4	10.81	17	45.95	16	43.24
Esotropia	541	124	22.92	258	47.69	159	29.39
Intermittent Esotropia	54	4	7.41	31	57.41	19	35.19
Exophoria	86	3	3.49	20	23.26	63	73.26
Exotropia	339	60	17.70	159	46.90	120	35.40
Intermittent Exotropia	125	30	24.00	59	47.20	36	28.80
Convergence Insufficiency	279	2	0.72	19	6.81	258	92.47
Accommodative Esotropia	117	17	14.53	75	64.10	25	21.37
Hypertropia	23	4	17.39	11	47.83	8	34.78
Third Nerve Palsy	15	5	33.33	3	20.00	7	46.67
Sixth Nerve Palsy	7	1	14.29	4	57.14	2	28.57
Nystagmus	307	56	18.24	127	41.37	124	40.39

Amblyopia is a common ocular motility disorder, with a high association in 26 out of 37 cases (70.27%), 382 out of 541 cases (70.61%), and 44 out of 54 cases (81.48%). It is present in 98 out of 339 cases (28.91%), a moderate association in 76 out of 125 cases (60.80%), and a significant association in 76 out of 125 cases (60.80%). Convergence Insufficiency is absent in all 279 cases (0.00%), while accomodative esotropia is present in 94 out of 117 cases (80.34%). Hypertropia is present in 19 out of 23 cases (82.61%), and in 1 out of 15 cases (6.67%). In 7 cases (0.00%), amblyopia is absent, and in 278 out of 307 cases (90.55%), it is present, indicating a very high association. (Table 4)

Table 4: Distribution of patients according to presence of amblyopia in different ocular motility disorders

Diagnosis	Amblyopia				
	Total	Present (n=1023)		Absent (n=907)	
		No.	%	No.	%
Esophoria	37	26	70.27	11	29.73
Esotropia	541	382	70.61	159	29.39
Intermittent Esotropia	54	44	81.48	10	18.52
Exophoria	86	5	5.81	81	94.19
Exotropia	339	98	28.91	241	71.09
Intermittent Exotropia	125	76	60.80	49	39.20
Convergence Insufficiency	279	0	0.00	279	100.00

Accommodative Esotropia	117	94	80.34	23	19.66
Hypertropia	23	19	82.61	4	17.39
Third Nerve Palsy	15	1	6.67	14	93.33
Sixth Nerve Palsy	7	0	0.00	7	100.00
Nystagmus	307	278	90.55	29	9.45

Out of a total of 57 cases, 57.44% were emmetropic, 54.98% were myopic, and 430.79.48% were hyperopic. Of these, 10.11% were emmetropic, 18.52%) were myopic, and 70.37%) were hyperopic. Out of 86 cases, 10.47% were emmetropic, and 60.47%) were hyperopic. Out of 339 cases, 29.50% were emmetropic, 28.80% were myopic, and 51.2% were hyperopic. Convergence Insufficiency was found in 93.91% of cases, while all 117 cases were hyperopic. Hypertropia was found in 8.70% of cases, 17.39% in 23 cases, and 73.91% in 73.91% in 23 cases. In the third nerve palsy, 26.67% of cases were emmetropic, and 6.67% was myopic. In the sixth nerve palsy, all cases were emmetropic. In the nystagmus, none were emmetropic, 27.69% were myopic, and 222 were hyperopic.(Table 5)

Table 5: Distribution of patients according to type of refractive error in different ocular motility disorders

	Refractive Error						
Diagnosis	Total	Emmetropia (n=479)		Myopia (n=335)		Hypermetropia (n-1116)	
		No.	%	No.	%	No.	%
Esophoria	37	7	18.92	4	10.81	26	70.27
Esotropia	541	57	10.54	54	9.98	430	79.48
Intermittent Esotropia	54	6	11.11	10	18.52	38	70.37
Exophoria	86	9	10.47	25	29.07	52	60.47
Exotropia	339	100	29.50	100	29.50	139	41.00
Intermittent Exotropia	125	25	20.00	36	28.80	64	51.20
Convergence Insufficiency	279	262	93.91	16	5.73	1	0.36
Accommodative Esotropia	117	0	0.00	0	0.00	117	100.00
Hypertropia	23	2	8.70	4	17.39	17	73.91
Third Nerve Palsy	15	4	26.67	1	6.67	10	66.67
Sixth Nerve Palsy	7	7	100.00	0	0.00	0	0.00
Nystagmus	307	0	0.00	85	27.69	222	72.31

The study analyzed various conditions, including esophoria, esotropia, convergence insufficiency, accomodative esotropia, hypertropia, third nerve palsy, sixth nerve palsy, and nystagmus. All 37 cases were managed conservatively, with no surgical interventions recorded. Out of 541 cases, 275 (50.83%) were managed conservatively, while 266 (49.17%) required surgery. Of 54 cases, 44 (81.48%) were conservatively managed, while 18.52%) required surgery. Out of 86 cases, 93.02%) were conservatively managed, while 6 (68%) required surgery. Out of 339 cases, 72 (21.24%) were conservatively managed, while 78.76%) required surgery. Convergence insufficiency was managed conservatively in all 279 cases. In 117 cases, 94 (80.34%) were conservatively managed, while 19 (19.66%) required surgery. (Table 6)

Table 6: Distribution of patients according treatment type in different ocular motility disorders

Diagnosis	Total	Conservative		Surgical	
		No.	%	No.	%
Esophoria	37	37	100	0	0
Esotropia	541	275	50.83	266	49.17
Intermittent Esotropia	54	44	81.48	10	18.52
Exophoria	86	80	93.02	6	6.98
Exotropia	339	72	21.24	267	78.76
Intermittent Exotropia	125	114	91.20	11	8.80
Convergence Insufficiency	279	279	100	0	0
Accommodative Esotropia	117	94	80.34	23	19.66
Hypertropia	23	4	17.39	19	82.61
Third Nerve Palsy	15	15	100	0	0
Sixth Nerve Palsy	7	5	71.43	2	28.57
Nystagmus	307	252	82.08	55	17.92

The study analyzed the distribution of patients with ocular motility disorders based on binocular fixation. Out of 541 cases, 86.4% showed binocular fixation, while 87.9% did not. In contrast, 117 cases showed binocular fixation, while 93 did not. Convergence Insufficiency showed binocular fixation in all 279 cases. Accommodative Esotropia showed binocular fixation in 20.51% of 117 cases, while 79.49% did not. Hypertropia showed binocular fixation in 17.39% of 23 cases, while 82.61% did not. In cases with third nerve palsy, 86.67% showed binocular fixation, while 1 did not. In cases with nystagmus, only 10.10% showed binocular fixation, while 89.90% did not. (Table 7)

Table 7: Distribution of patients according to presence of binocular fixation in different ocular motility disorders.

	Binocular fixation				
Diagnosis	Total	Present		Absent	
		No.	%	No.	%
Esophoria	37	37	100.00	0	0.00
Esotropia	541	90	16.64	451	83.36
Intermittent Esotropia	54	49	90.74	5	9.26
Exophoria	86	86	100.00	0	0.00
Exotropia	339	177	52.21	162	47.79
Intermittent Exotropia	125	113	90.40	12	9.60
Convergence Insufficiency	279	279	100.00	0	0.00
Accommodative Esotropia	117	24	20.51	93	79.49
Hypertropia	23	4	17.39	19	82.61
Third Nerve Palsy	15	13	86.67	2	13.33
Sixth Nerve Palsy	7	6	85.71	1	14.29
Nystagmus	307	31	10.10	276	89.90

DISCUSSION

Ocular motility disorders affect children's vision and development, with esotropia and exotropia being the most common forms. A study analyzing 1930 children aged 2-15 found that 28.03% were affected by esotropia, while 17.56% were affected by exotropia. Understanding the prevalence and gender distribution of these disorders is crucial for effective clinical management and public health strategies. These findings align with previous studies identifying these two types of strabismus as the most common in children. [7-9] Esotropia, an inward eye deviation, can be caused by accommodative, congenital, or acquired factors. If not treated, it can lead to amblyopia, emphasizing the need for early detection and intervention.[10] Severe cases can impair binocular vision, stereopsis, and depth perception.[11]

The study identified intermittent esotropia (2.80%) and intermittent exotropia (6.48%), which are challenging to diagnose and treat due to their varying ocular alignment.[12,13] Convergence insufficiency (14.46%) impairs near vision and binocular coordination, often requiring vision therapy.[14] Accommodative esotropia (6.06%) is associated with hypermetropia and requires corrective lenses and surgery. These conditions can make tasks like reading difficult and require careful observation and monitoring.[15] The study identifies eye movement disorders including nystagmus (15.91%) and phoria (1.92%), which can be congenital or acquired and require multidisciplinary treatment.[16] Phoria, where eyes deviate from normal alignment, can be treated conservatively with vision therapy.

The study reveals that ocular motility disorders are more common in males (56.22%) than females (43.78%), with a male to female ratio of 1.28. This pattern is consistent across various studies and research populations, suggesting a gender-specific susceptibility. Previous research has found that male children are more prone to ocular disorders, and environmental influences or gender-specific differences in behavior can influence ocular health.[17-22] Gender differences in

healthcare utilization and diagnostic habits may also affect the detection and reporting of eye problems.

The study analyzed the prevalence of ocular motility disorders in children, revealing that the most common disorders were esotropia (56.56% of males, 43.44% of females), exotropia (59.59% of males, 40.41% of females), and nystagmus (62.54% of males, 37.46% of females). Males had slightly more prevalence of accommodative esotropia (52.99%), while females had a higher prevalence of intermittent esotropia (62.96%). Convergence insufficiency was more prevalent in females (53.41%), and intermittent exotropia was slightly more common in females (50.40%). Third nerve palsy was more common in females (66.67%), while sixth nerve palsy was more common in males (71.43%). These gender differences highlight the importance of considering gender-specific factors in ocular disease assessment and treatment.

The majority of children aged 6-10 and 11-15 suffer from visual impairment and ocular motility anomalies, with only 16.06% being 2-15 years old. The mean age of children is 9.641±3.60 years. Children with developmental delays are more vulnerable to these conditions, with refractive errors being more prevalent among 11-15 year olds. Similar eye disorders have been observed in Nigeria, western China, Nepal, and Kathmandu, with refractive errors being a significant issue in ocular illness among students in Kathmandu. Further research is needed to better understand these conditions.[17,19,21-27]

Esotropia, a common eye condition in pediatric patients, is more prevalent in children aged 6-10, indicating significant development or external factors. Treatment interventions are needed for specific age groups. Nystagmus, a common eye abnormality in newborns and children, decreases as individuals age, with higher occurrence in younger children and stabilization in older ones. Early screening and treatment are crucial for positive visual outcomes, aligning with studies on pediatric nystagmus progression and natural course.

Convergence insufficiency is a common condition in older adolescents, especially during critical periods of scholastic and visual growth. It is crucial to provide treatment for these individuals. Pediatric ophthalmology in the emergency department is essential for identifying and managing convergence insufficiency.[28] Accommodative esotropia, a condition primarily seen in children aged 6-10 years, is influenced by accommodative mechanisms and is studied in children with special needs.

The study found that out of 1930 patients, 53.02% had amblyopia in childhood ocular motility disorders. Strabismus and amblyopia are the third most prevalent ocular illnesses, with a greater occurrence of convergent strabismus in children aged 0-5 years. In Nepal, 1.6% of school students were affected by strabismus, the second most prevalent ocular condition.[26] Variations in prevalence may be attributed to factors such as population composition, technique used, or geographical characteristics. In Shimla, North India, strabismus has a frequency of 2.5%, making it the second most frequent ocular condition.[27] In Tikrit Teaching Hospital's outpatient eye clinic, 12.1% of children had strabismus.[29]

Amblyopia and strabismus can negatively impact a child's visual acuity and overall well-being. Early detection and treatment are crucial to avoid permanent vision impairment. Efficient eye screening programs throughout preschool and school-age years are necessary for timely identification and treatment of ocular problems. In the study, 60.80% of intermittent exotropia, 70.27% of esophoria, 70.61% of esotropia, 80.34% of accommodative esotropia, 81.48% of intermittent esotropia, 82.61% of hypertropia, and 90.55% of nystagmus patients had amblyopia, showing a significant correlation between these strabismus and visual impairment.[7]

Intermittent esotropia has a higher rate of amblyopia (81.48%), indicating that uncorrected deviations can lead to severe visual impairment. Accommodative esotropia also has a high incidence of amblyopia (80.34%), highlighting the impact of refractive error and accommodative mechanisms on visual development in children.[30] Exotropia has a lower prevalence of amblyopia (28.91%), suggesting a specific risk profile. Exophoria (5.81%) rarely causes amblyopia, suggesting it may not cause significant visual loss. Convergence insufficiency does not cause amblyopia, and third nerve palsy has lower amblyopia rates (6.67%). Sixth nerve palsy does not cause amblyopia, suggesting it may not cause major visual impairment despite eye movement abnormalities. Understanding the prevalence of amblyopia in children is crucial for optimizing treatment techniques and improving visual outcomes in adolescent patients with various ocular diseases.

A study of 1930 children with ocular motility disorders found that hypermetropia was the most common refractive error. Most eye problems were refractive errors, with 31.6% of eye problems being refractive errors. Children with developmental delay had significantly higher refractive errors (74.47%) than the control group (38.29%).[23] Both studies suggest that children with developmental and ocular disorders need vision screening. Other studies have found similar eye problems in school children, with a significant prevalence of eye diseases, including refractive errors, in western China.[24,25] Vision screening of preschool children is underutilized, and refractive errors in children can lead to visual impairment. In Shimla, northern India, school children had significant rates of ocular disease, including refractive errors.[26,27]

A study found that emmetropia is more prevalent in convergence insufficiency (93.91%), while exophoria, exotropia, and intermittent exotropia are associated with myopia. Hypermetropia is the most common refractive error in these disorders, emphasizing the importance of correcting it for binocular coordination and nystagmus. The study also found that sixth nerve palsy is only observed in emmetropia (100.00%), indicating that a refractive error cannot cause this ocular movement disorder. Eye movement abnormalities like strabismus, amblyopia, and nystagmus are common in children and can impair visual development. Conservative treatment is effective for mild to moderate strabismus, while surgery is usually required for severe strabismus.[7,31,32] Underdeveloped countries are more likely to use conservative treatment for ocular motility disorders due to insufficient surgical resources, while more surgical options are available in developed countries.[33-35]

Ocular motility disorders in children are typically treated with conservative methods such as corrective lenses, occlusion treatment, and vision therapy. However, surgical intervention is reserved for cases where conservative methods fail. Early and appropriate treatment is necessary to prevent long-term visual impairment and improve the quality of life of affected children. A study found that 100% of patients with esophoria and convergence insufficiency were treated conservatively, while 93.02% of patients with exophoria were treated conservatively. In contrast, 81.48% of patients with intermittent esotropia were treated conservatively and 18.52% surgically. For intermittent exotropia, conservative treatment was recommended in 91.2% of cases, and surgery was the preferred treatment for hypertropia (82.61%). Nystagmus was treated conservatively in 82.08% of cases and surgically in 17.92%.

The study examined binocular fixation in 1930 patients with various ocular diagnoses. It found that binocular fixation was present in 100% of children with esophoria, exophoria, and convergence insufficiency. However, it was high in intermittent esotropia and exotropia. Hypertropia, third nerve palsy, and sixth nerve palsy had higher rates of binocular fixation. Nystagmus had the lowest rate of 10.10%. Esophoria and exophoria can cause eye displacement, affecting visual comfort and performance. Refractive assessment and correction are crucial for optimizing visual outcomes.

The study on adult onset ocular motility disorders in children aged 2-15 has limitations, including selection bias, inaccurate records, and resource constraints. It recommends a multidisciplinary approach, standardized diagnostic protocols, timely intervention, and advanced diagnostic tools.

CONCLUSION

The study involved 1930 patients with a male to female ratio of 1.28, with a prevalence of amblyopia in 53.01% of cases. Treatment approaches were conservative in 65.85% and surgical in 34.15% of cases. Non-paralytic eye movement disorders were dominated by esodeviation and exodeviation in 83% of cases. Paralytic disorders affected 1.14% of patients, primarily with third nerve palsy. Gender differences showed higher rates of esophoria, esotropia, and intermittent esotropia in males, while convergence insufficiency was more common in females.

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