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Investigation of the effectiveness of teledermatology in the diagnosis of skin lesions in pediatric patients

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SUMMARY

OBJECTIVE: Teledermatology is the use of communications technology to enable the remote evaluation of skin lesions. Dermatological complaints are common among pediatric patients and should be handled differently than adults. The aim of this study is to group the dermatological lesions of pediatric patients who visited a dermatology outpatient clinic and to investigate in which groups the teledermatology method is more effective.

METHODS: This is a prospective observational study. Images of skin lesions, which were examined face-to-face in a dermatology outpatient clinic, were transmitted to another dermatologist via telecommunication. The diagnoses by the physician who examined patients face-to-face were compared with the diagnoses by the teledermatologist. Informed consent was obtained from the parents or legal representatives of all patients participating in this study.

RESULTS: A total of 93 pediatric patients were evaluated. In our study, the diagnoses by a dermatologist who evaluated patients face-to-face and the diagnoses by a teledermatologist were in agreement with 74.2% of the time. There was 100% agreement between both dermatologists for the diagnosis of acne and scabies. The diagnosis for verruca was consistent with 91.7% of the time, and for atopic dermatitis, it was 72.7%. There was a 25% consistency between both dermatologists on the diagnosis of contact dermatitis. The diagnostic consistency between both physicians was 53% in the erythematous disease group, 89% in the papulopustular group, and 70% in the pigmented group.

CONCLUSION: Teledermatology is a reliable diagnostic method that shortens the waiting time of patients and provides a quick consultation with a dermatologist. When using the teledermatology method, it is important to know which skin lesions or disease groups are more accurately diagnosed.

KEYWORDS: Skin disease. Pediatrics. Telemedicine. Diagnosis.

INTRODUCTION

Teledermatology is an alternative examination method that enables remote evaluation of skin lesions of patients using visual communication technologies[1]. Its use has been increasing in recent years. Therefore, studies are needed to confirm the clinical accuracy, safety, and efficacy of the teledermatology method. Dermatological complaints are common in pediatric patients, and approximately 10–30% of all patients admitted to the hospital have skin lesions[2]. Skin diseases seen in children should be handled differently than in adults. There are frequently encountered differences with children, such as diseases specific to the pediatric period, different side effects of treatments, and different treatment strategies. Long appointment times for examination and the need for the patient to apply to more than one department cause dissatisfaction of the patients and their relatives, as well as an increase in health expenses[3]. Effective use of teledermatology can be beneficial in such cases. In addition, due to this method, other physicians (pediatricians, emergency physicians, etc.) can obtain a dermatologist's opinion on skin lesions they are not familiar with[2,4,5]. As the body is not evaluated as a whole and palpation cannot be performed in teledermatology, more studies should be conducted to evaluate its effectiveness.

The aim of this study is to group the dermatological lesions of pediatric patients who applied to the dermatology outpatient clinic and to investigate in which groups the teledermatology method is more effective.

METHODS

Patients below 16 years of age who visited the dermatology department of the University Hospital between April 15, 2022 and November 1, 2022, were included in this prospective and observational study. Informed consent was obtained from the parents or legal representatives of all patients participating in this study. Those who refused to participate in the study and those who did not accept imaging of skin lesions were excluded from this study (Figure 1).

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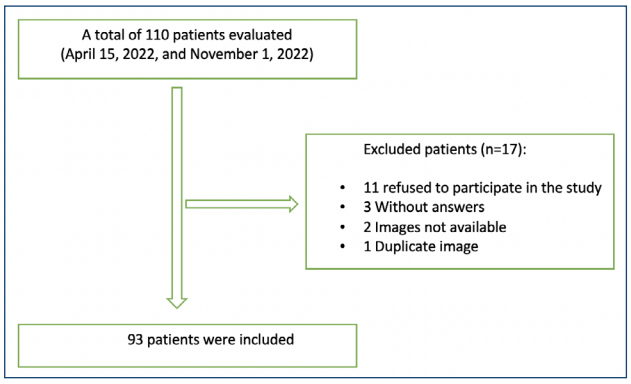

Figure 1. Patient flow chart.

Patients with visible skin lesions, high-resolution photographs, and previously undiagnosed conditions were included in this study. Images of the skin lesions of patients who were examined face-to-face in the dermatology outpatient clinic were transmitted to another dermatologist via telecommunication. The physicians were in different hospitals and did not see each other. A mobile phone with a 16-MP camera was used to photograph the lesions.

The photo shoot was standardized as much as possible, and a neutral background was preferred. Photographs of the lesion area were taken without the use of flash in a well-lit room using autofocus. The teledermatologist numbered each image, added the date and time, and recorded it on a prepared form. At the end of the day, both physicians compared the patients' diagnoses. In this way, the dermatological lesion group in which the teledermatology method was effective was determined. Since teledermatology is based on images, skin lesions were divided into four groups according to their appearance: erythematous, papulopustular, pigmented lesions, and hair diseases.

The approval number 2022-399 dated 10.01.2023 was obtained from the University Ethics Committee to allow the study to be conducted.

Statistics

The behavior of quantitative variables was expressed using centralization and measures of variance: mean±SD. Exact measuring (where the sample size is low) and chi-square tests were used to identify differences in ratios or relationships between categorical variables. To show the behavioral differences of the group, the Mann–Whitney U-test method was used. Statistical significance was determined as p=0.05 for all cases. Statistical analyses were provided with the IBM SPSS (Statistics Package for Social Sciences for Windows, Version 21.0, NY, IBM Corp.) software program.

RESULTS

A total of 93 patients were evaluated, of whom 52 (55.9%) were females and 41 (44.1%) were males. The mean age was 11.03±4.62. There were 24 diagnosed diseases after the face-to-face examinations. The most common diagnoses were acne vulgaris in 14 (15.1%), verruca in 12 (12.9%), scabies in 11 (11.8%), and atopic dermatitis in 11 (11.8%). Among the disease groups, there were 34 patients (36.6%) in the erythematous group, 45 (48.4%) in the papulopustular group, 10 (10.8%) in the pigmented group, and 4 (4.3%) with hair diseases. When evaluated in terms of the duration of the disease, 26 (28%) patients were evaluated as acute and 67 (72%) patients as chronic. The diagnoses by the dermatologist who evaluated the patients face-to-face and through teledermatology were consistent 74.2% of the time. Diagnoses and demographic information of the patients are shown in Table 1.

There was 100% agreement between both dermatologists for diagnoses of acne and scabies. Verruca diagnosis was consistent 91.7% of the time, and atopic dermatitis 72.7%. However, there was only 25% agreement between both dermatologists on the diagnosis of contact dermatitis; and it was found to be statistically significant (p<0.001). The patients were divided into four groups (erythematous, papulopustular, pigmented, and hair diseases). The agreement between the diagnoses of both physicians was 53% in the erythematous disease group, 89% in the papulopustular group, and 70% in the pigmented group (p=0.001). Rates of correct diagnoses by the teledermatological method in the erythematous disease group were lower compared with other groups. The difference between the other groups was statistically significant (p=0.001). For papulopustular, the rate of teledermatologically correct diagnoses was higher in the disease group compared with the other groups (p=0.001).

DISCUSSION

In the field of dermatology, where visuality is important, teledermatology comes to the fore. Studies have shown that the teledermatology method has been used successfully during the COVID-19 pandemic[6-8]. These studies have generally been conducted among adult patients. There are very few studies investigating the effectiveness of pediatric teledermatology. In our study, there was 74.2% agreement between the diagnoses of the dermatologist who examined the patients face-to-face and the teledermatologist. In a study by Chen et al., the consistency among the physicians was 48%[9]. Heffner et al. reported this rate as 82%[10]. In another study conducted to investigate the effectiveness of the teledermatology method, there was an agreement of 78% among the diagnoses[11].

Table 1. Demographic and clinical characteristics.

		n (%)	Dermatologist diagnosis (Teledermatology)		p-value
			Diagnostic Agreement		
			Yes 69 (74.2)	No 24 (25.8)	
Age (mean±SD)	Year	11.03±4.62	11.22±4.51	10.5±4.98	0.566
Gender	Female	52 (55.9)	39 (75)	13 (25)	1.000
	Male	41 (44.1)	30 (73.2)	11 (26.8)	
Duration of the disease	Acute	26 (28)	16 (62)	10 (38)	0.141
	Chronic	67 (72)	53 (79)	14 (21)	
Disease group	Erythematous	34 (36.6)	18 (53)	16 (47)	0.001
	Papulopustular	45 (48.4)	40 (89)	5 (11)	
	Pigmented	10 (10.8)	7 (70)	3 (30)	
Dermatologist diagnosis (face-to-face)	Acne vulgaris	14 (15.1)	14 (100)	0 (0)	<0.001
	Verruca	12 (12.9)	11 (91.7)	1 (8.3)	
	Scabies	11 (11.8)	11 (100)	0 (0)	
	Contact dermatitis	8 (8.6)	2 (25)	6 (75)	
	Atopic dermatitis	11 (11.8)	8 (72.7)	3 (27.3)	

Acne vulgaris is a common skin disease. A total of 85–100% of people may encounter this disease at some point in their lives. Studies have shown that the diagnosis of acne is effectively diagnosed through teledermatology[12]. Similarly, in a study involving 2,459 patients using the teledermatology method, the diagnosis of acne was 99% accurate[13]. In our study, there was 100% agreement between the diagnoses of both physicians in all the acne patients. In a study, in which the treatment and follow-up of patients diagnosed with acne were conducted by teledermatology, patient satisfaction was found to be 92.3%[14]. Acne is a disease that needs to be diagnosed and treated quickly due to the scars and post-inflammatory hyperpigmentation it can leave on the skin. As it is not always possible for patients to reach dermatology outpatient clinics, it is considered safe to manage the diagnosis and treatment of patients by consulting a dermatologist via teledermatology in primary care.

Surprisingly, there was 100% consensus among physicians about the diagnosis of scabies. This may be due to good imaging of scabies-specific lesions and obtaining a good anamnesis from the patient. The use of teledermatology as an effective tool in diagnosing scabies is important. Thus, scabies patients can be diagnosed easily and quickly. Possible outbreaks can be prevented by isolating these people from crowded environments and raising awareness about the disease[15]. In one study, scabies marks and crusting were seen on the skin of a patient whose photographs were brought by family members. Afterward, the patient was successfully diagnosed for scabies[16].

Atopic dermatitis is an important global public health problem. These patients should be diagnosed early and followed up closely. In a study conducted by Giavina-Bianchi et al., the accuracy rate of diagnosis of atopic dermatitis via the teledermatology method was 84.4%[17]. In our study, the diagnosis of atopic dermatitis was the third most common diagnosis. In other studies, this diagnosis is the most common or the second most common diagnosis among pediatric patients[17,18]. It is important to use the teledermatology method in the diagnosis of atopic dermatitis because it is one of the most common diseases during the pediatric period. Using teledermatology is important because it eliminates the need for a face-to-face appointment with a dermatologist. In a study conducted by Mehrtens et al., they found that the teledermatology method provided approximately 40% of reduction in face-to-face examination appointments[19].

Diagnostic accuracy was low in cases of erythema, and this was consistent with similar studies in the literature[9]. In one study, teledermatological diagnostic agreement was found to be lower in such diseases as seborrheic dermatitis, pityriasis rosea, and xerosis with erythema and scaling compared with other diseases[20]. This may be because erythematous diseases have a wide list of differential diagnoses. In a study by Warshaw et al., the diagnostic agreement of pigmented lesions with the teledermatology method was found to be 81%[21]. In our study, even if 70% correct diagnosis was made with the teledermatology method in patients with pigmented skin

lesions, teledermatology should be used with caution, given the potential for malignancy of pigmented lesions.

This method can provide benefits in many respects, such as obtaining a dermatologist's opinion on patients in a short time frame and reducing waiting times and costs. Pediatricians frequently encounter patients with dermatological complaints and may have difficulties in diagnosing them. In one study investigating the dermatological diagnosis accuracy of pediatric patients, pediatricians made the correct diagnosis in only 76% of the patients[22]. Hence, it is important to contact a dermatologist at regular intervals. In another study, it was reported that the dermatology patients had a longest examination waiting period among all pediatric diseases, and teledermatology shortened this period significantly and served as a kind of triage[23]. Yet, in another study, the teledermatology method was shown to be very effective in the diagnosis of common skin lesions[24]. We believe that making more frequent and optimized use of teledermatology will be beneficial for public health. As research on teledermatology increases, effective areas of use can be determined, and guidelines and standards can be updated in this way.

Limitations

A non-diverse study population and a relatively small number of patients were the limitations.

CONCLUSION

Teledermatology is a reliable diagnostic method that shortens the waiting time of the patients and provides a quick consultation with the dermatologist. While using the teledermatology method, it is important to know the skin lesions or disease groups for which it is more effective. The teledermatology method may allow the dermatological evaluation of patients during quarantine periods, such as the COVID-19 pandemic, and natural disasters, including earthquakes.

HUMAN RIGHTS STATEMENTS AND INFORMED CONSENT

All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Declaration of Helsinki 1964 and its later amendments.

CONSENT

Informed consent was obtained from the parents or legal representatives of all patients participating in this study.

CONSENT FOR PUBLICATION

There are no details on individuals reported in the article. Consent for publication is not applicable in our study.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

The approval number 2022-399 dated 10.01.2023 was obtained from the Bezmialem Vakif University Ethics Committee to allow the study to be conducted.

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AUTHORS' CONTRIBUTIONS

NT: Conceptualization, Data curation, Formal Analysis, Funding acquisition Investigation, Methodology, Validation, Visualization, Writing – original draft, Writing – review & editing. **OSK:** Data curation, Formal Analysis, Project administration, Resources, Supervision, Writing – original draft, Writing – review & editing.

REFERENCES

1. Trettel A, Eissing L, Augustin M. Telemedicine in dermatology: findings and experiences worldwide - a systematic literature review. J Eur Acad Dermatol Venereol. 2018;32(2):215-4. https://doi.org/10.1111/jdv.14341
2. Prindaville B, Antaya RJ, Siegfried EC. Pediatric dermatology: past, present, and future. Pediatr Dermatol. 2015;32(1):1-12. https://doi.org/10.1111/pde.12362
3. Jones K, Lennon E, McCathie K, Millar A, Isles C, McFadyen A, et al. Teledermatology to reduce face-to-face appointments in general practice during the COVID-19 pandemic: a quality improvement project. BMJ Open Qual. 2022;11(2):e001789. https://doi.org/10.1136/bmjoq-2021-001789
4. Jiang SW, Flynn MS, Kwock JT, Liu B, Quow K, Blanchard SK, et al. Quality and perceived usefulness of patient-submitted store-and-forward teledermatology images. JAMA Dermatol. 2022;158(10):1183-6. https://doi.org/10.1001/jamadermatol.2022.2815
5. Pasadyn SR, McAfee JL, Vij A, Warren CB. Store-and-forward teledermatology impact on diagnosis, treatment and dermatology referrals: Comparison between practice settings. J Telemed Telecare. 2022;28(3):177-81. https://doi.org/10.1177/1357633X20925269
6. Taslidere N, Su Kucuk O. Can a correct diagnosis be established using the teledermatology method? Acta Dermatovenerol Croat. 2022;30(1):32-9. PMID: 36153717
7. Nami N, Massone C, Rubegni P, Cevenini G, Fimiani M, Hofmann-Wellenhof R. Concordance and time estimation of store-and-

forward mobile teledermatology compared to classical face-to-face consultation. Acta Derm Venereol. 2015;95(1):35-9. https://doi.org/10.2340/00015555-1876

8. Ruggiero A, Megna M, Annunziata MC, Abategiovanni L, Scalvenzi M, Tajani A, et al. Teledermatology for acne during COVID-19: high patients' satisfaction in spite of the emergency. J Eur Acad Dermatol Venereol. 2020;34(11):e662-3. https://doi.org/10.1111/jdv.16746
9. Chen TS, Goldyne ME, Mathes EFD, Frieden IJ, Gilliam AE. Pediatric teledermatology: observations based on 429 consults. J Am Acad Dermatol. 2010;62(1):61-6. https://doi.org/10.1016/j.jaad.2009.05.039
10. Heffner VA, Lyon VB, Brousseau DC, Holland KE, Yen K. Store-and-forward teledermatology versus in-person visits: a comparison in pediatric teledermatology clinic. J Am Acad Dermatol. 2009;60(6):956-61. https://doi.org/10.1016/j.jaad.2008.11.026
11. Giavina-Bianchi M, Sousa R, Cordioli E. Part I: accuracy of teledermatology in inflammatory dermatoses. Front Med (Lausanne). 2020;7:585792. https://doi.org/10.3389/fmed.2020.585792
12. Frühauf J, Kröck S, Quehenberger F, Kopera D, Fink-Puches R, Komericki P, et al. Mobile teledermatology helping patients control high-need acne: a randomized controlled trial. J Eur Acad Dermatol Venereol. 2015;29(5):919-24. https://doi.org/10.1111/jdv.12723
13. Giavina-Bianchi M, Azevedo MFD, Cordioli E. Clinical features of acne in primary care patients assessed through teledermatology. J Prim Care Community Health. 2022;13:21501319221074117. https://doi.org/10.1177/21501319221074117
14. Gu L, Lipner SR. Review of telemedicine for management of acne patients. J Cutan Med Surg. 2022;26(4):393-97. https://doi.org/10.1177/12034754221083978
15. Lee CH, Huang CC, Huang JT, Wang CC, Fan S, Wang PS, et al. Live-interactive teledermatology program in Taiwan: one-year experience serving a district hospital in rural Taitung County. J Formos Med Assoc. 2021;120(1 Pt 2):422-8. https://doi.org/10.1016/j.jfma.2020.06.007
16. Bimbi C, Wollina U, Kyriakou G, Dalla Lana DF, Ramos M. Basic teledermatology solving two cases of crusted scabies. Dermatol Ther. 2020;33(6):e14214. https://doi.org/10.1111/dth.14214
17. Giavina-Bianchi M, Giavina-Bianchi P, Santos AP, Rizzo LV, Cordioli E. Accuracy and efficiency of telemedicine in atopic dermatitis. JAAD Int. 2020;1(2):175-81. https://doi.org/10.1016/j.jdin.2020.08.002
18. Wollenberg A, Barbarot S, Bieber T, Christen-Zaech S, Deleuran M, Fink-Wagner A, et al. Consensus-based European guidelines for treatment of atopic eczema (atopic dermatitis) in adults and children: part I. J Eur Acad Dermatol Venereol. 2018;32(5):657-82. https://doi.org/10.1111/jdv.14891
19. Mehrtens SH, Shall L, Halpern SM. A 14-year review of a UK teledermatology service: experience of over 40 000 teleconsultations. Clin Exp Dermatol. 2019;44(8):874-81. https://doi.org/10.1111/ced.13928
20. Naka F, Makkar H, Lu J. Teledermatology: kids are not just little people. Clin Dermatol. 2017;35(6):594-600. https://doi.org/10.1016/j.clindermatol.2017.08.009
21. Warshaw EM, Lederle FA, Grill JP, Gravely AA, Bangerter AK, Fortier LA, et al. Accuracy of teledermatology for pigmented neoplasms. J Am Acad Dermatol. 2009;61(5):753-65. https://doi.org/10.1016/j.jaad.2009.04.032
22. Gehris RP, Herman EIX. Pediatric teledermatology: a review. Curr Derm Rep 2020;9:114-22.
23. Seiger K, Hawryluk EB, Kroshinsky D, Kvedar JC, Das S. Pediatric dermatology eConsults: reduced wait times and dermatology office visits. Pediatr Dermatol. 2020;37(5):804-10. https://doi.org/10.1111/pde.14187
24. Fogel AL, Teng JM. Pediatric teledermatology: a survey of usage, perspectives, and practice. Pediatr Dermatol. 2015;32(3):363-8. https://doi.org/10.1111/pde.12533