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RESEARCH

DEMODEX (ACARI: DEMODICIDAE) INFESTATION IN THE ELDERLY AND ITS RELATIONSHIP WITH THE SKIN PARAMETERS SUCH AS MOISTURE, PH, AND TEMPERATURE: A CROSS-SECTIONAL STUDY

ABSTRACT

Introduction: The elderly population is growing both worldwide and in Turkey. Thus, the importance of studies on elderly individuals is increasing. The present study was conducted to evaluate Demodex infestation and its relationship with the skin parameters such as moisture, pH, and temperature in elderly individuals living in nursing homes.

Materials and Method: The study included 91 elderly individuals who were residents of Erzincan 100th Anniversary Atatürk Nursing Home. Skin moisture, pH, and temperature were measured, and skin samples were collected from the cheek, nasolabial area, and chin using the standard superficial skin biopsy method, and the specimens were examined by light microscopy.

Results: Overall, Demodex mites (mean 31.1/cm2) were detected in 85.7% elderly individuals; 84.6% had D. folliculorum (mean 29.3/cm2) and 45.1% had D. brevis (mean 4.3/cm2) infestation. The infestations were mostly found in the cheek (mean 21.2/cm2), followed by the nasolabial area (mean 9.4/cm2) and the chin (mean 7.4/cm2). The difference between facial areas and Demodex infestation was statistically significant (p<0.001). Demodex infestation was higher in those with a dry skin, with a skin pH of 5.6-7.0 and with an elevated skin temperature. The relationship between the density of Demodex and skin moisture was statistically significant (p=0.035), whereas the relationship with skin pH and temperature was not statistically significant.

Conclusion: Elderly individuals which having dry skin, elevated skin temperature, and high skin pH have been more infested with Demodex mites. It may be helpful to consider this finding in clinical assessment of skin lesions and dermatoses in geriatric patients.

Key Words: Aged; Mites; Nursing home; Prevalence; Skin

ARAŞTIRMA

YAŞLILARDA DEMODEX (ACARİ: DEMODİCİDAE) ENFESTASYONU VE CİLDİN NEM, PH VE ISI PARAMETRELERİ İLE İLİŞKİSİ: KESİTSEL BİR ÇALIŞMA

ÖZ

Giriş: Tüm dünyada olduğu gibi ülkemizde de her geçen yıl yaşlı nüfusu artmaktadır. Bu nedenle yaşlı bireylerle ilgili yapılacak olan çalışmalar büyük öneme sahiptir. Bu çalışma huzurevinde kalan yaşlılarda Demodex enfestasyonunu belirlemek ve cildin nem, pH ve ısı parametreleriyle olan ilişkisini ortaya koymak amacıyla yapıldı.

Gereç ve Yöntem: Çalışmaya Erzincan 100. Yıl Atatürk Huzurevinde kalan 91 yaşlı dahil edildi. Yaşlıların cilt nemi, cilt pH'sı ve cilt ısısı ölçülerek yanak, nazolabiyal ve çene bölgelerinden Standart Yüzeyel Deri Biyopsi (SYDB) yöntemi ile örnekler alındı ve ışık mikroskobunda incelendi.

Bulgular: Yaşlılardan %84.6'sında D. folliculorum (mean 29.3/cm2), %45.1'inde D. brevis (mean 4.3/cm2) olmak üzere %85.7'sinde Demodex mites (mean 31.1/cm2) tespit edildi. Enfestasyonun en fazla yanakta olduğu (ortalama 21.2/cm2), bunu sırasıyla nazolabial (ortalama 9.4/cm2) ve çene (ortalama 7.4/cm2) bölgesinin izlediği görüldü. Yüz bölgeleri ile Demodex enfestasyonu arasındaki fark istatistiki bakımdan anlamlı bulundu (p<0.001). Demodex enfestasyonunun cildi kuru olanlarda, cilt pH'sı 5.6-7.0 olanlarda ve cilt ısısı yüksek olanlarda daha fazla olduğu tespit edildi. Demodex enfestasyonu ile cilt nemi arasındaki fark istatistiki olarak anlamlıyken (p=0.035), cilt pH ve ısısı ile arasındaki fark anlamlı değildi.

Sonuç: Yaşlılardan cildi kuru, cilt ısısı yüksek ve cilt pH'sı yüksek olanların Demodex akarlarla daha fazla enfeste olduğu görüldü. Bu durumun geriatrik hastalardaki cilt lezyonları ve dermatozların klinik değerlendirmesinde göz önünde bulundurulması faydalı olabilir.

Anahtar Sözcükler: Akar; Cilt; Huzurevi; Prevalans; Yaşlılar

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INTRODUCTION

Two species of *Demodex* mites (Acari: Demodicidae) belonging to the phylum Arthropoda living on humans have been identified. Of these species, *D. folliculorum* has a longer body and is found in hair follicles, whereas *D. brevis* has a shorter body and lives in sebaceous glands. The mite has pin-like mouthparts and various enzymes for digesting follicular epithelial cells. The mite has an average life cycle of 15 days. The adult form is 0.3-0.4 mm long and has four pairs of legs (1, 2).

In human hosts, the cheek, nose, chin, eyelashes, and nasolabial area are the most common sites of infestation, and the parasite is rarely seen in other parts of the body such as genital organs, breasts, scalp, neck, external ear canal (1, 3-5). *Demodex* mites sometimes remain as commensals in hair follicles of healthy individuals without creating any pathogenic effect, while they could become opportunistic pathogens in cases of compromised skin hygiene and immunosuppression. In addition, the parasite is considered to play a role in the pathogenesis of acne, rosacea, perioral dermatitis, seborrheic dermatitis, and blepharitis (1, 3-8).

The elderly population is growing worldwide as well as in Turkey. As of 2016, individuals aged >65 years account for 8.3% of the general population. This rate is projected to increase to approximately 30% by 2050 (9). Thus, dermatologists and physicians in other disciplines are more likely to encounter geriatric patients in the future. Thus, the importance of studies on elderly individuals is increasing. There are many studies in the literature evaluating the elderly from the perspective of dermatological care (10-14). On the other hand, numerous studies have been conducted to determine the prevalence of *Demodex* infestation in various patient populations and age groups (3-8). However, no particular study has been conducted in relation to *Demodex* infestation in elderly individuals living in nursing homes or comprised of individuals aged >65 years only. The present study was conducted to evaluate *Demodex* infestation and its relationship with the skin parameters such as moisture, pH, and temperature in elderly individuals living in nursing homes.

MATERIALS AND METHOD

Study Sample

The study was conducted in Erzincan 100th Anniversary Atatürk Nursing Home on April 2016. After providing explanations to 103 elderly individuals aged 65-95 years living in the nursing home, 91 volunteers (41 females, 50 males) who were able to communicate and who did not have an apparent facial dermatosis were included in the study. Necessary permissions were obtained from the Erzincan Provincial Directorate of Family and Social Policies and Erzincan University Ethics Committee (Decision no: 2015-01/6). All participants signed an informed consent form prepared in accordance with Helsinki Declaration.

Collection of Samples

The samples were collected and examined by the same researcher (corresponding author). The samples were collected from the cheek, nasolabial area, and chin using Standard Superficial Skin Biopsy method. Sample collection site was cleaned with alcohol and dried. A 1-cm^2 area was marked on a clean glass slide. A drop was cyanoacrylate was deposited on the other side of the glass slide, which was then pressed slightly onto the collection site and removed gently after 1 min.

Examination of Samples

Hoyer's solution was mounted on the samples and covered with a coverslip. The slides were examined by light microscopy (Leica DM500, Switzerland) at 4×, 10×, and 40× magnifications. Mite species were identified in light of the literature data (2). The mean density of *Demodex* mites per cm^2 of skin was calculated by dividing the total number of *Demodex* mites to the number of infested participants.

Measurement of Skin Moisture, pH, and Temperature

Skin moisture (RH%) was measured using a digital moisture meter (DMM, Turkey), and skin pH and temperature were measured using a skin pH meter (Hanna HI 1414, Romania). Measurements were made at the cheek area which are known to be one of the areas where *Demodex* mites are most prevalent

(4-6, 8, 15). Thus, mites isolated from the cheek area were taken into consideration while evaluating the relationship between skin moisture, pH, and temperature and *Demodex* infestation. Skin moisture measurement was according to the criteria set out in the instructions manual of the manufacturer. RH values of < 30% were defined as "low" moisture content, those of 30% - 50% were defined as "moderate" moisture content, and those of >50% were defined as "high" moisture content. In addition, demographic features of the participants and other data were retrieved from the nursing home records.

Data Analysis

The data were analyzed using SPSS 20.0 (Statistical Package for Social Sciences; Chicago, IL, USA) software package. The Kolmogorov–Smirnov test was used to check for normal distribution of variables. Non-parametric Mann-Whitney U-test and Kruskal-Wallis test were used to compare non-normally distributed variables between the groups. The chi-square test was used to compare categorical data. A p value of <0.05 was considered statistically significant.

RESULTS

The mean age was 80.2 ± 9.0 years among females (n = 41) and 76.2 ± 7.9 years among males (n = 50).

Overall, *Demodex* mites (mean 31.1/cm^2) were detected in 85.7% elderly individuals; 84.6% individuals had *D. folliculorum* (mean 29.3/cm^2) and 45.1% had *D. brevis* (mean 4.3/cm^2) infestation (Fig. 1).

The infestations were mostly found in the cheek (mean 21.2/cm^2), followed by the nasolabial area (mean 9.4/cm^2) and the chin (mean 7.4/cm^2). The difference between *Demodex* infestation and facial areas was statistically significant (p < 0.001; Fig. 2).

The value of skin moisture, pH, and skin temperature of the elderly individuals are presented in Figure 3. In the study, *Demodex* mites were detected in 88.5% individuals with low skin moisture content (mean 26.0/cm^2) and 74.4% individuals with moderate skin moisture content (mean 13.5/cm^2). There were no elderly individuals with high skin moisture content. On the other hand, *Demodex* mites were detected in 83.3% individuals with skin a pH of 4.0-5.5 (mean 14.6/cm^2) and in 82.1% individuals with a skin pH of 5.6-7.0 (mean 23.5/cm^2). It was found that 78.3% individuals had skin temperature of 18.0°C-23.0°C (mean 17.3/cm^2), and 86.7% individuals had skin temperature of 23.1°C-28.0°C (mean 24.7/cm^2). There was a significant difference in the density of *Demodex* mites according to skin moisture levels (p = 0.035). However, there was no significant relationship between skin pH, skin temperature, and the density of *Demodex* mites (Table 1).
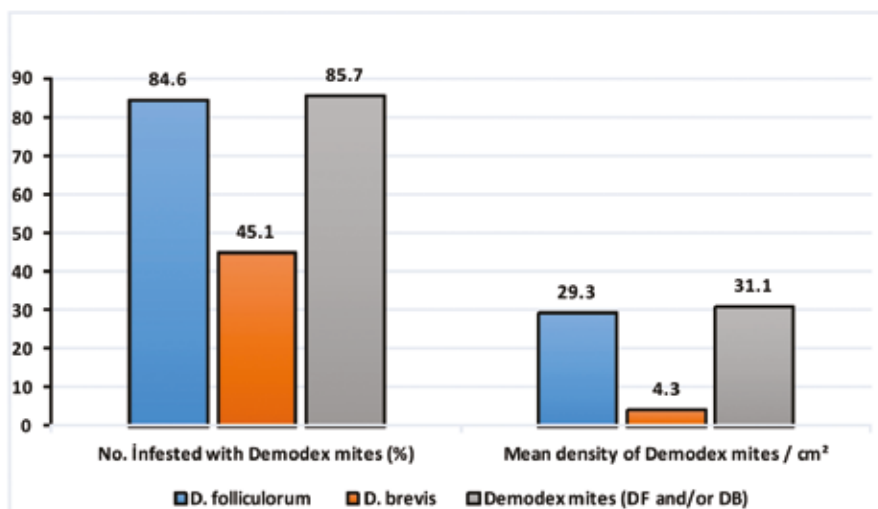

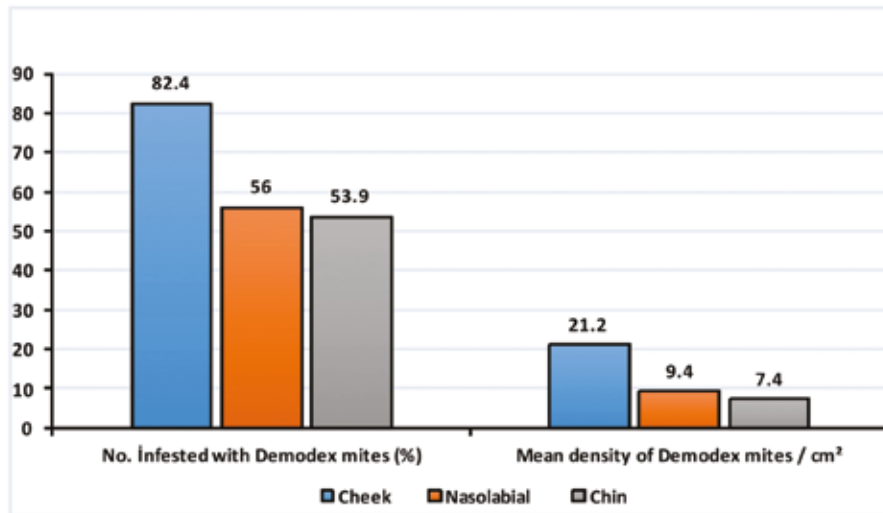**Figure 1.** The infestation of *Demodex* mites in elderly

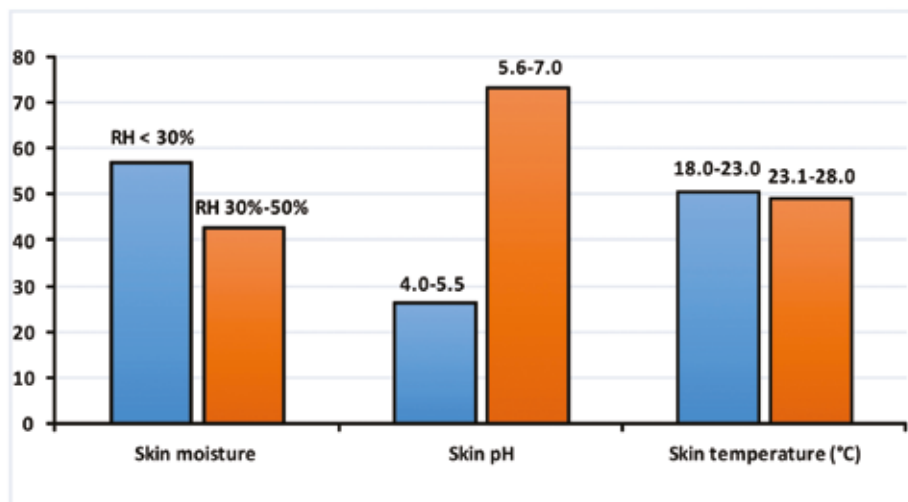**Figure 2.** The distribution of *Demodex* mites in facial region

Figure 3. The value of skin moisture, skin pH and skin temperature in elderly

When assessed according to the demographic features, *Demodex* mites was detected in 87.8% females (mean 40.2/cm^2) and 84% males (mean 23.4/cm^2); in addition, *Demodex* was detected in 96.7% individuals aged 65-74 years (mean 24.4/cm^2), 78.1% individuals aged 75-84 years (mean 34.7/cm^2), and 80.8% individuals aged 85-95 years (mean density 37.2/cm^2). With regard to literacy status, *Demodex* mites was detected in 83.8% literate individuals (mean 23.3/cm^2) and 87.0% illiterate individuals (mean 36.3/cm^2). The relationship between gender and density of *Demodex* mites was statistically significant (p = 0.031), whereas age and literacy status were not significantly related to the density of *Demodex* mites (Table 1).

Table 1. The relationship between *Demodex* infestation and skin moisture, skin pH, skin temperature, demographic characteristics and other parameter

		No. infested with *Demodex* mites	Mean density of *Demodex* mites /cm^2	P
Age (year)	65 - 74	32 / 33 (96.7%)	24.4	
	75 - 84	25 / 32 (78.1%)	34.7	0.599*
	85 - 95	21 / 26 (80.8%)	37.2	
Gender	Female	36 / 41(87.8%)	40.2	0.031**
	Male	42 / 50 (84.0%)	23.4	
Literacy status	Literate	31 / 37 (83.8%)	23.3	0.057**
	Illiterate	47 / 54 (87.0%)	36.3	
Rehabilitation services	Receiving	41 / 47 (87.2%)	33.8	0.990**
	Not receiving	37 / 44 (84.1%)	28.2	
Admitted to way the nursing home	Paid	35 / 41 (85.4%)	24.6	0.817**
	Unpaid	43 / 50 (86.0%)	36.5	
Living time in nursing homes (year)	1-2	27 / 30 (90.0%)	27.2	
	3-4	23 / 27 (85.2%)	25.7	0.833*
	5+	28 / 34 (82.4%)	39.4	
Daily medications	Yes	49 / 56 (87.5%)	37.8	0.018**
	No	29 / 35 (82.9%)	19.9	
Skin moisture	RH < 30%	46 / 52 (88.5%)	26.0	0.035**
	RH 30% - 50%	29 / 39 (74.4%)	13.5	
Skin pH	4.0 - 5.5	20 / 24 (83.3%)	14.6	0.403**
	5.6 - 7.0	55 / 67 (82.1%)	23.5	
Skin temperature	18.0°C - 23.0°C	36 / 46 (78.3%)	17.3	0.090**
	23.1°C - 28.0°C	39 / 45 (86.7%)	24.7	

* Kruskal Wallis test; ** Mann Whitney U test

Demodex mites was detected in 87.2% individuals receiving rehabilitation services (mean 33.8/cm^2) and in 84.1% individuals who did not receive rehabilitation services (mean 28.2/cm^2). In addition, *De-* *modex* was detected in 85.4% individuals who were admitted to the nursing home as a paid service (mean 24.6/cm^2) and in 86.0% individuals who were admitted to the nursing home as an unpaid service (mean

36.5/cm^2). *Demodex* was detected in 90% individuals who were residents of the nursing home for 1-2 years (mean 27.2/cm^2), 85.2% individuals who have lived in the nursing home for 3-4 years (mean 25.7/cm^2), and 82.4% individuals who have lived in the nursing home for >5 years (mean 39.4/cm^2). Finally, *Demodex* was detected in 87.5% individuals who were on daily medications (mean 37.8/cm^2) and 82.9% individuals who did not receive daily medications (mean 19.9/cm^2). The differences between the groups were not statistically significant, except for daily medication use (p = 0.018) (Table 1).

DISCUSSION

Although *Demodex* mites can be found in healthy young persons and particularly elderly without creating any pathogenic effect, they could causing clinical symptoms such as acne, rosacea, perioral dermatitis, seborrheic dermatitis and blepharitis if the immune system of the host is suppressed or do not pay attention to hygienic practices. On the other hand, the elderly population is growing both worldwide and in Turkey. Thus, clinicians are more likely to encounter geriatric patients with dermatological ailments. Thus, the importance of studies on elderly individuals is increasing. There are many studies in the literature about *Demodex* mites prevalence. However, until today no particular study has been conducted to *Demodex* infestation in elderly individuals living in nursing homes. The present study was conducted to evaluate *Demodex* infestation and its relationship with the skin biophysical parameters in elderly individuals living in nursing homes.

In the present study overall, *Demodex* mites (mean 31.1/cm^2) were detected in 85.7% 91 elderly individuals; 84.6% had *D. folliculorum* (mean 29.3/cm^2) and 45.1% had *D. brevis* (mean 4.3/cm^2). Other studies have reported a prevalence rate of *Demodex* mites ranging from 19.7% to 74% and a density ranging from 0.84/cm^2 to 4.4/cm^2 in healthy individuals aged >65 years (6, 8, 15-19). Besides, *Demodex* infestation is very common among the healthy young population either. In our previous study on

healthy persons, we reported that the density of *Demodex* mites was 50.1% in university students and 69.3% in the university staff (20). The prevalence rate and density found for *Demodex* mites in the present study are higher than those reported in other studies. This may be caused by methodological differences in the study (i.e., use of cellophane strips, squeezing the skin or the Superficial Skin Biopsy technique), and from living conditions in nursing home, and also from different hygienic behaviors of participants. Consistent with the literature (4, 15, 21, 22), however, *D. folliculorum* was more prevalent than *D. brevis*. This may be caused by the fact that *D. brevis* lives in deeper structures of the skin surface (sebaceous glands attached to the hair follicles), whereas *D. folliculorum* lives in the outer surfaces of the hair follicles (closer to the skin surface) and are more easily isolated.

Various studies have reported that *Demodex* mites could be found other body parts such as genital organs, breasts, scalp, neck, external ear canal in addition to the facial region, but infestation mostly occurs in the facial region and cheeks in which high amount of sebum could cause this (4-6, 8, 15). In the present study, the infestations were mostly found in the cheek (mean 21.2/cm^2) followed by the nasolabial area (mean 9.4/cm^2) and the chin (mean 7.4/cm^2).

Stratum corneum (SC), the outermost layer of the epidermis, is a natural barrier preventing water loss through the skin. However, in elderly individuals, there is an increased loss of water and dry skin (xerosis) because of impaired skin repair and thinning of SC, and the barrier function of the skin is disrupted (5, 14, 23). In the present study, 57.2% elderly individuals had dry skin (RH <30%) and 42.8% had moderate skin moisture content (RH 30%-50%); no individuals had high skin moisture content (RH >50%). In addition, the mean number of *Demodex* mites was 2-fold higher in individuals with dry skin than in those with moderate level of skin moisture content. In our previous study, we reported that the density of *Demodex* mites was higher in healthy

people with a lower skin moisture, however the differences was not significant (20).

Raghallaigh et al. reported that patients with papulopustular rosacea had high skin pH and these patients often suffered from dry skin and sensitivity (24). Another study reported more alkaline skin pH in healthy individuals with *Demodex* infestation than in those without *Demodex* infestation (18). Similarly, Demirdag et al. reported that the skin pH on the cheek of patients with demodicosis was more alkaline, and increased skin pH was suggested to negatively influence water permeability of SC and its barrier functions (5). The other study by Zeytun et al reported that the density of mites was higher in healthy people with a skin pH of 5.1-6.5, however the difference was also not significant (20). Similar to the findings of the present study, 73.6% elderly individuals had a skin pH of 5.6-7.0 and 26.4% had a skin pH of 4.5-5.5; in addition, and the density of *Demodex* mites was 1.6-fold higher in the elderly individuals with a high skin pH than in individuals with a low skin pH.

The number of elderly individuals with a skin temperature of 18.0°C-23.0°C was comparable to the number of individuals with a body temperature of 23.1°C-28.0°C. However, the density of *Demodex* was 1.5-fold higher in individuals with a skin temperature of 23.1°C-28.0°C than in those with a body temperature of 18.0°C-23.0°C. Similarly, in our previous study, we reported that the density of *Demodex* mites was higher in healthy people in those with a skin temperature 24-28°C (20). Various studies have reported dry skin with increasing transepidermal water loss, which in turn results in the impairment of the barrier function of the skin (25, 26). In addition, impaired barrier function of the skin may cause increased proliferation of *Demodex* mites.

One of the most important risk factors for *Demodex* mites infestation is hygienic behaviors of participants. Forton et al. reported that the majority of patients with demodicosis (62%) did not use soap to wash their faces (7). Washing with soap and water probably helps fight mite proliferation by mechanical (face cloth) and chemical (soap) actions, those showing the importance of hygiene. The other study by Zeytun et al reported that *Demodex* mites were very prevalent in healthy individuals who washed their face only once a day, did not use personal face towel (20).

Various studies have reported higher prevalence and density of *Demodex* in individuals aged ≥65 years with poor hygiene practices and self-care, individuals with low educational level and economic status, patients on daily medications, and in immunosuppressed patients (3, 4, 7, 15). The present study also found higher density of *Demodex* in illiterate individuals, receiving rehabilitation services, individuals living unpaid in nursing homes, individuals living in nursing homes for >5 years, and those who use medications daily. This finding can be explained by the fact that most individuals living in the nursing homes require support for their personal care, they pay insufficient attention to personal hygiene practices, and that they have weakened immune system than in young individuals.

In conclusion, elderly individuals which having dry skin, elevated skin temperature, and an high skin pH have been more infested with *Demodex*. However, this topic is necessary investigate with further studies that was used as the control group of elderly individuals who not residing in nursing home. The findings of this study by made basic science researchers may be consider in clinical assessment of skin lesions and dermatoses in geriatric patients. In addition, this study is important in terms of may be guiding for multidisciplinary works conduct of healthcare professionals together with researchers from the basic sciences.

ACKNOWLEDGEMENT

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