

The Adherent Cylindrical Nit Structure and Its Chemical Denaturation In Vitro: An Assessment With Therapeutic Implications for Head Lice

P*ediculus humanus capitis* is the insect responsible for head lice. During the female louse's 30-day lifespan, she lays approximately 10 eggs per day and attaches each of them with a glue-like, waterproof substance to human hair, 1 mm from the scalp. Larvae emerge 8 to 10 days later from these nits, or eggs, which remain firmly attached to hair.

No topical agent has been shown to be 100% ovicidal.¹ The existence of any nits, a major aspect of lice infestations, signifies the potential that this contagious malady may still be present. Many schools, therefore, adhere to a "no-nit" policy before children can reenter the classroom after infestation, thereby imposing prolonged absenteeism. Insecticides fail to kill all nits and larvae because they act on the insects' central nervous systems, which are not fully developed in the first 4 days of the insects' existence. Several products, namely, Clear lice egg remover gel (Care Technologies, Greenwich, Conn), Step 2 (Genderm, Lincolnshire, Ill), and a 50/50 mixture of vinegar and water, have been suggested as beneficial in nit removal. However, no clinical benefit has been documented in the medical literature.²

The purpose of our investigation was to examine attachment of nits to the hair shaft and to test several substances for their effectiveness in facilitating nit removal from hair. Samples of adult lice and hairs with nits attached were obtained from affected patients. No attempt was made to designate specific nits or lice from any particular person.

Our first assessment was microscopic examination of the appearance of the nit structure. With hairs intact, nits were noted to be firmly attached to the hair shaft by a cylindrical adherent material, the nit itself being part of the distal portion of the sheath (**Figure 1**). Lengths of cylindrical bands varied slightly. As nits were freed from hair, the cylindrical bands remained intact (**Figure 2**).

The following agents were investigated as to whether they facilitate sliding of nit casts from the hair shaft: WD-40 (WD-40 Co, San Diego, Calif), vinegar, Detachol (Ferndale Laboratories Inc, Ferndale, Mich), acetone, Step 2, Clear topical lice egg remover gel, bleach, vodka, bug and tar remover (for cars), all-purpose degreaser and cleaner (for kitchen use), Royale with actein ("no-fungus shampoo," Straight Arrow, Leigh Valley, Pa), Osler Tangle Remover for dogs (Osler Professional Products, McMinnville, Tenn), petrolatum, dental plaque remover solution, 20% potassium hydroxide in dimethyl sulfoxide, and liquid nitrogen. No agent proved therapeutically efficacious. Products that seemed to assist mildly in nit removal included bleach, vodka, dental plaque remover

solution, and vinegar, both at room temperature and heated. Interestingly, 20% potassium hydroxide in dimethyl sulfoxide dissolved the hair shaft without any discernible effect on the cylindrical nit cast.

Live adult lice were placed in petrolatum and 2 pomades (Proclaim Conditioning Hair Dress [Brentwood Beauty Laboratories, Hillside, Ill] and Soft Sheen Sportin' Waves [Soft Sheen Products, Chicago, Ill]). Pomades are medicated ointments for hair used most commonly by African Americans. With all 3 substances, lice were unable to continue movement of appendages and died within 15 minutes.

Nits were tested for assessment of chemical constituents and denaturation by acids or proteases under the microscope. In 6-mol/L hydrochloric acid, the sheath assumed a more bulky configuration within seconds. In 12-mol/L hydrochloric acid, the sheath lost its structural integrity, expanding its surface area 3-fold, while maintaining only a semblance of attachment to the nit. The louse egg itself remained unaffected in both solutions. Iodine test for carbohydrates was applied to the

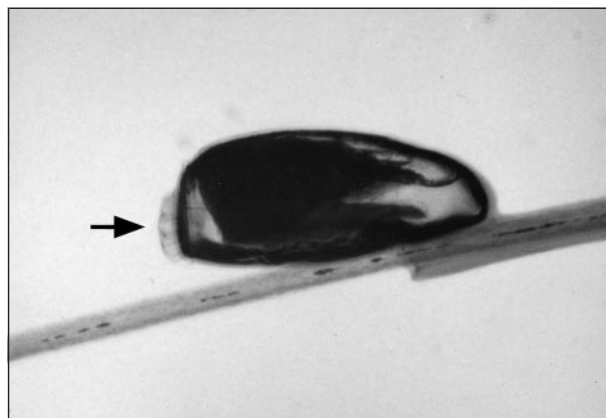


Figure 1. The louse nit with its adherent cylindrical sheath cemented to the hair shaft. The free, distal end of the nit would be directed toward the hair tip. The egg has a domed operculum (arrow) that embodies air holes, allowing the maturing larvae to breathe. The sheath length varies.

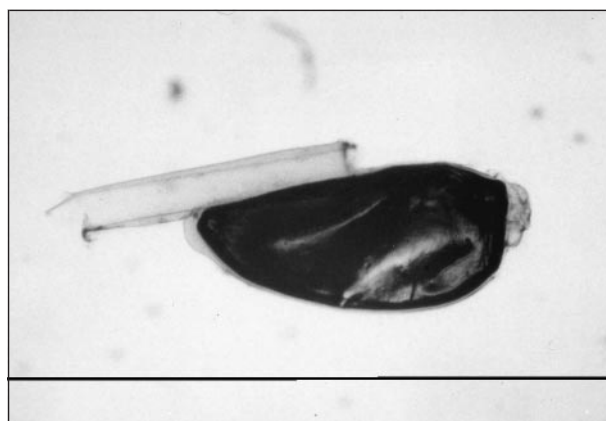


Figure 2. The cylindrical nit after sliding off the hair shaft remains intact with no discernible alteration in anatomical structure.

nit sheath both before and after denaturation with 6-mol/L hydrochloric acid. In both instances, iodine stained the cylindrical nit structure, suggesting the sheath is a complex carbohydrate.

The cylindrical portion of nit structure does not disintegrate or fracture off with combing, liquid nitrogen, insecticides, or washing. None of the common substances used in this study had any visible effect. Once the firm bond between the nit sheath and hair is loosened, both structures retain their structural integrity under light microscopic examination. Thus, in terms of removal of nits, the structure presently has to be slid off the hair shaft. This should help patients and parents understand why fine combing and manual removal is necessary to eradicate this problem.

Petrolatum has been used in the treatment of adult lice,³ but has no effect on egg viability. It is most difficult to remove from hair even after repeated washings, causing dust and other particles to adhere to the resultant greasy hair. Pomades are more readily washed out of hair. With several patients, we have verified that a thick application of pomade overnight is equally therapeutic to petrolatum for eradication of adult lice. Cosmetically, these are the obvious choice over petrolatum for those patients who refuse insecticides. Inasmuch as pomades do not kill nits, this therapy should be repeated weekly for 4 weeks to smother newly hatched lice.

From our studies, it seems that agents that damage the hair shaft or allow shrinkage of keratin have minimal effect on nit removal. An alternative method in nit removal would be dissolution, or weakening of the nit cylindrical structure itself. The nit sheath seems to be a complex carbohydrate, as supported by iodine staining. Amino acid analysis from the University of Michigan Protein and Carbohydrate Structure Facility, Ann Arbor, revealed the nit sheath to be devoid of any proteinous constituent. Our studies do indeed reveal that the nit cylindrical structure is denatured with acids in vitro, and chemical nit removal may be in the future. Complex carbohydrates can often be hydrolyzed with catalases and/or by acid hydrolysis.^{4,5} The importance of our study is the verification that chemical nit removal is a possibility; in fact, we can now do it in vitro.

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Television and Childhood Injuries: Is There a Connection?

Fourteen years ago the American Academy of Pediatrics published an initial report¹ on the potential of television to stimulate aggressive and violent behavior, and since then considerable evidence has been accumulated to support these preliminary findings.²⁻⁵ In 1976, Daven et al⁶ reported on 3 cases of children severely injured while trying to imitate motorcycle daredevil Evel Knievel. After numerous studies of television influence on real-life violence, including 2 major government commissions, the industry is experimenting with a 7 to 9 PM. "Family Hour" from which violence, along with sex, has been largely banished. In 1973, 18 032 young Americans, 15 to 24 years of age, died in motor vehicle crashes, 5182 were murdered, and 4098 committed suicide. The death rate, for this age group, was 19% higher in 1973-1974 than it had been in 1960-1961, owing entirely to deaths by violence.⁷ Despite these various studies, however, we still know very little about the effect that television exerts on the intellectual and emotional development of children. According to several reports,¹ an average child and adolescent watches television between 21 and 23 hours per week and this fact may lead us to suspect that, as this activity is the leisure activity that takes up the greater part of day, the child will not be involved in other potentially more injury-generating pursuits and thus television viewing will tend to result in a reduction in injuries. Nevertheless, from another standpoint, the influence of television on the child's emotional adaptation to his or her environment²⁻⁷ could well be related to a greater incidence of accidents, a conclusion that remains to be verified.

The aim of this study was to compare television viewing time in a cohort of children hospitalized because of injuries or for some other reasons.

Patients, Materials, and Methods. This is a study carried out at the Santa Ana Hospital in Motril (a province of Granada, Spain) between October 1995 and June 1996. The adult accompanying every child admitted to the pediatric ward of the hospital during that period was asked to fill out a form in which they were asked to provide each parents' age in years, the number of hours per day their son or daughter habitually watched television, the number of siblings, the number of television sets in the household, the television channel that is seen preferably in the house, the favorite type of program chosen by the parents, and the attitude the parents had to the type of programs their offspring watched. We collected 221 questionnaires. Part of the information provided was whether the child had been admitted for reasons of incidents that caused physical injuries, such as fractures, multiple contusions, or burns; 47 of the patients fell into this category. To evaluate the relationship between the risk of accidents among children and the length of time they spend watching television, we used a logistical regression model⁸ within which we also incorporated the existence of variables that might confuse or modify the effect, such as the existence of first-order interactions.

We have evaluated several regression models to explain adequately the risks of injuries to children, using the minimum number of variables according to the criteria put forward by Kleinbaum et al.⁸ In a first analysis, we separately used the following variables: parents' supervision of television viewing, hours per day the child devoted to watching television, and the number of television sets in the home.

Results. The mean (\pm SD) age of the children admitted was 7.5 (\pm 3.7) years and that of the parents was 38 (\pm 6.7) years for the father and 33.5 (\pm 7.5) years for the mother. According to the different series,⁹⁻¹¹ the incidence of events and their leading to injuries and physical injuries in general in children accounts for between 12% and 22% of hospital emergencies. In our study, the frequency of events causing physical injury was 21%. The 48.9% of children watch television for more than 2 hours a day. The parents of 20.2% of the children admitted because of physical injury considered that screen violence may be a determining factor in future aggressive or antisocial conduct, whereas 28.6% of parents with children admitted for similar reasons had no qualms about the effect of television violence on the emotional development of their children. The parents of 21.3% of such children believed that violence on the television is excessive. We did not find differences among the television channels that were seen by both groups of children ($\chi^2 = 11.69$; $P = .16$). The favorite programs that were chosen by parents of both groups were educational documentaries (in 29 of 140 injured children) and animated features (in 14 of 72 injured children); we did not find differences between the television preferences of both studied groups ($\chi^2_4 = 8.63$; $P = .07$). The logistic regression model showed an accident relative risk of $e^{0.2919}$, or 1.34 for each hour per day of television viewing (95% confidence interval, 1.02 - 1.75); the age of the child and the number of televisions in the home were adjustable variables in the equation. A child viewing 4 hours of television per day (the US average) has a relative risk of $e^{0.2919 \times 4}$, or 4.3.

Comment. As has been established in other studies, the association that exists between the number of hours a day spent watching television and violent conduct cannot be explained by a hypothetical affinity between children of a more aggressive nature and violent entertainment.^{12,13} Without any doubt, the effect of television on its viewers is directly related to the number of hours spent in watching per day and the content of the programs watched.¹⁴⁻¹⁶ According to Strasburger,¹⁷ an average child today, on reaching age 70 will have devoted between 7 and 10 years of his or her life watching television. Various studies¹⁸ have related watching television with violent or aggressive conduct during adolescence.

The American Academy of Pediatrics¹ advises that parents should participate in the choice of television program content watched by their children, to be able to better control the effect of television over their child's emotional development. According to the results stemming from our research, only control over the number of hours that children spend watching television will have

any influence on the rate of juvenile injuries. Paradoxically, a child who spends more time watching television and devotes fewer hours to potentially more dangerous physical activities and games is at greater risk of experiencing events that cause physical injuries. We believe that the depiction of a distorted reality on the television screen, which the child perceives as being real, may be of some help in explaining our findings. According to the social theory of learning, certain forms of conduct that entail an element of risk of injury may be stimulated by example, as in this case by watching such conduct on the television screen.^{18,19} According to this idea then, children who spend more hours watching television may receive a greater number of distorted messages about reality that become converted into false real-life experiences and distort the child's adaptation to his or her surrounding environment. In the same way that Hapkiewicz and Stone²⁰ consider more realistic television programs distort one's perception of reality more than those programs with a high fiction content, without a doubt the child's judgment and critical judgment faculty concerning what he or she is watching is based on different motivations¹²; and in any case, the parents' judgment and guidance should be fundamental and decisive. In this respect, Klein et al²¹ find an increase in risk-taking behaviors in teenagers heavily exposed to the mass media; although more studies are needed with regard to this, we can suggest similar pathological mechanisms in children and adolescents. We also feel that the various specialist and government organizations should continue to collect information from family members and the children themselves to study the potentially harmful effect television might have on the emotional and intellectual development of children.

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Don't Compromise the Medical Home

The article by Shefer et al¹ in the January 1998 issue of the ARCHIVES provoked considerable discussion. While there is absolutely no question that we need to do more to make sure that all children are fully immunized according to the American Academy of Pediatrics/Centers for Disease Control and Prevention schedule and at the appropriate times, I have difficulty believing that linkage to the Women, Infants, and Children (WIC) program is the answer. Certainly it is no more the answer than linking immunizations to day-care attendance, emergency department visits, shopping excursions at the mall, or perhaps even to preventive health maintenance visits at the pediatrician's office.

The article begs a question with respect to the relative importance of a variety of health interventions in an infant's life. Pediatricians and the American Academy of Pediatrics have long promoted the importance of the "medical home." We do think that children in a medical home do better with respect to a variety of parameters. If this is indeed the case (and certainly the evidence is at least as strong for the importance of a medical home as it is for the importance of the WIC program), perhaps the WIC program should be based in pediatricians' offices, so that services for these children can be truly comprehensive. In the meantime, let's not fragment the health care of our children more than it already is.

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1. Shefer A, Mezzoff J, Caspari D, Bolton M, Herrick P. What mothers in the Women, Infants, and Children (WIC) program feel about WIC and immunization linkage activities: a summary of focus groups in Wisconsin. *Arch Pediatr Adolesc Med.* 1998;152:65-70.

In reply

We appreciate the comments by Drs Zanga and Bar-on on our recent article published in the ARCHIVES.¹ We wish to respond to their concerns and clarify some issues.

Conducting immunization-specific interventions within the WIC program includes the assessment of each child's immunization status with a documented immunization history and referral of every underimmunized child to his or her medical home. Any additional interventions are specific to the local WIC program and do not form the basis of the WIC-immunization linkage strategy.

The single most effective strategy in increasing vaccine coverage and reducing the incidence of vaccine-preventable diseases in school-aged children was not done through the health care system but through the implementation of school laws.^{2,3} We view WIC-immunization linkage activities in the same way as school laws. Just as school entry laws were instrumental in increasing and maintaining vaccine coverage to more than 90% for school-aged children in this country, a similar requirement for vaccine coverage in WIC would have the potential to raise preschool vaccine coverage to similar levels.

These WIC-immunization linkage activities have been shown in multiple studies to dramatically improve preschool vaccine coverage within a relatively short period.^{4,5} There is little evidence to support the linking of immunization activities to some of the other activities Drs Zanga and Bar-on mention. Indeed, a lack of success has been shown in linking immunization activities to emergency department visits.⁶ The WIC program is very well organized, captures more than 45% of the annual birth cohort, and through the issuance of substantial financial subsidies in the way of food vouchers to program participants is unique in that it has a captive audience targeted to low-income, at-risk families.

We also believe that vaccinating children belongs in the child's primary care medical home. However, there are still many improvements that need to be made to establish effective mechanisms to hold caregivers accountable for the population served.⁷ Many providers still don't follow Advisory Committee on Immunization Practices/American Academy of Pediatrics recommendations to routinely measure immunization coverage among their children served through the "clinic assessment" method.⁸ Providers need to improve the accuracy and frequency of information collected about immunization coverage in clearly defined populations.

We agree that the potential for fragmentation of health care is an important issue. Although mothers in WIC mentioned that obtaining immunizations at the same time and place as WIC would be convenient, we believe that the optimum WIC linkage intervention includes referral of every underimmunized child back to his or her medical provider. Primary care providers may actually benefit from linking with the WIC program—as a result of WIC staff referring underimmunized children back to their medical home, improvements not only in vaccination coverage but also in preventive care (frequency of well-child care visits) can occur at the provider practice level. As an innovative approach to public-private partnerships, locating WIC services in pediatrician's offices is an interesting idea. A managed care group in Detroit, Mich, with 93% of its enrollees receiving Medicaid benefits, has successfully placed on-site WIC services at 4 of its primary care provider sites,

with initial promising increases in vaccination coverage and a reduction in no-show rates for primary care visits.⁹

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Henoch-Schönlein Purpura

I found the article by Drs Daly and Siegel¹ in the January 1998 issue of the ARCHIVES to be very interesting but quite troublesome.

The authors mention quite accurately that Henoch-Schönlein purpura is a vasculitis involving the skin, gastrointestinal tract, joints, and kidneys. Several years ago I reviewed all admissions to 3 local university hospitals for Henoch-Schönlein purpura from 1980 to 1990. The **Table** shows the frequency of hospitalization for testicular involvement (swelling and tenderness) mimicking testicular torsion. I would like to suggest that genital involvement is a major cause of Henoch-Schönlein purpura hospital admissions in males.

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Testicular Involvement of Males Hospitalized With Henoch-Schönlein Purpura, 3 Hospitals, 1980-1990

Hospital	No. (%) of Male Cases With Testicular Swelling and Tenderness		
	Male	Female	Total
1	16	1	17
2	28	23	51
3	11	1	12
Total	55	25	80

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1. Daly KC, Siegel RM. Henoch-Schönlein purpura in a child at risk of abuse. *Arch Pediatr Adolesc Med.* 1998;152:96-98.

Objective Structured Clinical Examination in Pediatrics

I read with great interest the article by Hilliard et al¹ in the January 1998 issue of the ARCHIVES. As a pediatrician with considerable experience in organizing objective structured clinical examinations for undergraduates during the past 10 years, I have the following suggestions to make the examination both more interesting and more objective for the residents and less traumatic for the children who may be used as subjects.

I have used short video recordings (1-1½ minutes) showing various abnormal movements (such as choreoathetosis and dystonia), cerebellar signs, examination of a floppy infant, various types of seizures, and normal developmental examination results. For postgraduate residents, more complex problems such as Rett syndrome may be used. In such a setting, it is essential to give a brief history before the resident switches on the videotape. The candidate is then asked to answer a series of questions.

Slides under a microscope showing peripheral blood pictures in various hematological disorders and Gram-stained smears showing gram-positive or -negative cocci/bacilli in pairs, chains, or clusters can be used successfully. Once again, a short caption is given along with the slides (ie, "a 1-month-old infant is brought with fever and a bulging fontanel; the cerebrospinal fluid has been stained with Gram stain. . . ")

Interpretation of electrocardiogram tracings, x-rays, computed tomographic scans, and lung function test results is routinely used as a part of objective structured clinical examination in most centers. Similarly, photographs or slides showing different dermatological findings are often used in objective structured clinical examinations.

When a child has to be used as a subject, we take care to use an older child with a heart murmur or lung findings. Children with hepatosplenomegaly or neurologic findings are not routinely used so as to minimize the inconvenience resulting from examination by more than 10 students. However, if children with similar findings can be found (such as children with thalassemia and hepatosplenomegaly), it is possible to switch patients after examination by 4 or 5 students.

I use 10 stations of 6 minutes each. The examination is arranged in a large lecture hall with screens separating the stations. For patients, small cubicles are arranged.

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