



# Is the Hair Probative or from the Laundry?

## Probative Value of Hair in Households in which the Suspect and Victim Have Co-Mingled Laundry

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### ABSTRACT

Analyzing evidence for trace hair evidence is a regular practice in forensic science. Sometimes there may be a considerable time gap between the commission of a crime and a suspect being determined. The presence or absence of “supporting evidence” such as hair can be the difference between filing charges or not. Many of these cases are sexual assault cases where the victim and suspect live in the same house. This brings up the question of the probative value of hairs that are found on items submitted for analysis. It is important to realize that clothing collected in these circumstances may have altered because of wear, washing, or other treatment. The authors wish to investigate one of these factors: laundering. Is it possible that the hair evidence could have originated by secondary transfer from the laundering process?

This study is being carried out in an attempt to help interpret real case findings where hair evidence was found on underwear after being laundered. The clean examined items will be laundered with other person’s clothing then examined in order to determine if any hairs were transferred to the item in the laundering process.

The authors realize that it is naïve to expect that the results will always give an unequivocal answer. It is hoped that this study will narrow the number of possibilities.

### INTRODUCTION

Analyzing evidence for trace hair evidence is a regular practice in forensic science. Hair is one of the most common types of trace evidence (1). Almost all human beings have some hair; and hair can be easily transferred from one person to another, to the clothing of another or to the scene. The results of forensic hair examinations in some cases provide important investigative, associative and elimination information. The Scientific Working Group on Materials Analysis has published guidelines for procedures for the forensic analysis of hair evidence (2). References and an extensive bibliography concerning hair analysis can be found in that published document. The examination of clothing is a frequent process when investigating sex crimes involving children. Research, however, shows that children who have been sexually assaulted often have considerable difficulty in revealing or discussing their abuse. Estimates suggest that only 3% of all cases of child sexual abuse and only 12% of rapes involving children are ever reported to police (3, 4, 5). This reluctance to report can lead to a considerable time gap between the commission of a crime and a suspect being determined. The time gap also greatly diminishes the ability to find traditional sexual assault evidence, so investigators look to physical items to provide trace evidence to substantiate the allegation. Clothing is often chosen as hair may be found on clothing for a considerable length of time. Underwear is an item of clothing selected because it is an unshared item and usually worn near the site of the assault. Many of these cases are sexual assault cases where the victim and suspect live in the same house. Living in the same house, the victim and suspect are exposed to a co-mingled laundry situation. Co-mingling can include co-mingling in the hamper, washing machine, dryer, folding or transporting. This brings up the question of the probative value of hairs that are found on items submitted for analysis. It is important to realize that clothing collected in these circumstances may have altered because of wear, washing or other treatment. This study addresses one of these factors: laundering. Is it possible that the hair evidence could have originated by secondary transfer from the laundering process?

### Men’s Underwear

Column1	Household #1	Household #2	Household #3	Household #4	Household #5	Household #6	Household #7	Household #8	Household #9	Household #10	Household #11
Findings after Washing #1	No Human 2 animal hairs	No Human 10 animal hairs	1 CBH 7 animal hairs	No Human 9 animal hairs	No Human 5 animal hairs	No Human 1 animal hairs	1 CBH 66 animal hairs	No Human 1 animal hairs	1 NHF 1 CHH 1 CHH 1 CHH 2 CHH 2 CHH 2 CHH No animal hairs	No Human 1 animal hairs	No Human 1 animal hairs
Findings after Washing #2	No Human 6 animal hairs	No Human 4 animal hairs	1 CBH 8 animal hairs	1 CBH 8 animal hairs	No Human 1 animal hairs	No Human 1 animal hairs	No Human 1 animal hairs	No Human 1 animal hairs	No Human 1 animal hairs	1 CHH 1 CHH 1 CHH No animal hairs	No Human 1 animal hairs
Findings after Washing #3	No Human 3 animal hairs	3 CHF 2 animal hairs	No Human 19 animal hairs	1 CHH 22 animal hairs	No Human 1 animal hairs	No Human 1 animal hairs	No Human 2 animal hairs	No Human 1 animal hairs	No Human 1 animal hairs	1 MHF 1 CHH 1 CHH No animal hairs	1 CHH 1 CHH No animal hairs
Findings after Washing #4	3 CHF 6 animal hairs	No Human 1 animal hairs	No Human 4 animal hairs	1 CHH 18 animal hairs	1 CHH 5 animal hairs	No Human 1 animal hairs	No Human 6 animal hairs	No Human 1 animal hairs	No Human 1 animal hairs	1 CBH 1 CHH 1 CHH 1 CHH 1 CHH No animal hairs	1 CHH 1 CHH No animal hairs
Findings after Washing #5	No Human 1 animal hairs	1 CBH 19 animal hairs	1 CHH 5 animal hairs	1 CHH 18 animal hairs	1 CHH 2 animal hairs	1 CHH 2 animal hairs	1 MHF 7 animal hairs	No Human 1 animal hairs	1 NHF 1 CHH 1 CHH No animal hairs	1 CHH 1 CHH 1 CHH No animal hairs	1 CHH 1 CHH No animal hairs
Findings after Washing #6	No Human 1 animal hairs	No Human 4 animal hairs	No Human 8 animal hairs	1 CHH 4 animal hairs	1 CHH 3 animal hairs	No Human 1 animal hairs	No Human 1 animal hairs	No Human 1 animal hairs	No Human 1 animal hairs	No Human 1 animal hairs	2 CHH 1 CHH 1 CHH No animal hairs
Findings after Washing #7	No Human 4 animal hairs	No Human 1 animal hairs	1 CHH 2 animal hairs	1 CHH 11 animal hairs	1 CHH 1 animal hairs	No Human 1 animal hairs	No Human 11 animal hairs	1 MHF 1 animal hairs	No Human 1 animal hairs	1 CHH 2 CHH 2 CHH No animal hairs	1 CHH 2 CHH No animal hairs
Findings after Washing #8	No Human 2 animal hairs	No Human 2 animal hairs	No Human 2 animal hairs	No Human 14 animal hairs	No Human 11 animal hairs	No Human 1 animal hairs	1 MHF 18 animal hairs	1 MHF 1 animal hairs	1 NHF 1 CHH 1 CHH No animal hairs	No Human 1 animal hairs	No Human 1 animal hairs
Findings after Washing #9	No Human 9 animal hairs	2 CHH 2 animal hairs	1 CHH 12 animal hairs	1 CHH 1 animal hairs	1 CHH 1 animal hairs	No Human 1 animal hairs	No Human 1 animal hairs	No Human 1 animal hairs	No Human 1 animal hairs	No Human 1 animal hairs	5 CHH 1 CHH No animal hairs
Findings after Washing #10	No Human 3 animal hairs	1 CHH 2 animal hairs	No Human 3 animal hairs	1 CHH 3 animal hairs	No Human 1 animal hairs	No Human 1 animal hairs	No Human 1 animal hairs	No Human 1 animal hairs	No Human 1 animal hairs	No Human 1 animal hairs	1 CHH 1 CHH No animal hairs

### Women’s Underwear

Column1	Household #1	Household #2	Household #3	Household #4	Household #5	Household #6	Household #7	Household #8	Household #9	Household #10	Household #11
Findings after Washing #1	No Human 4 animal hairs	1 CHH 7 animal hairs	1 CBH 2MHF 16 animal hairs	No Human 8 animal hairs	No Human 4 animal hairs	No Human 2 animal hairs	No Human 1 animal hairs	2 CHH 1 CHH 21 CHH 37 animal hairs	No Human 1 animal hairs	1 CHF 1 CHF No animal hairs	2 CHH 3 CHH 3 CHH No animal hairs
Findings after Washing #2	No Human 1 clump of animal hairs	No Human 1 animal hairs	No Human 1 animal hairs	No Human 6 animal hairs	1 CHH 2 animal hairs	No Human 1 animal hairs	No Human 1 animal hairs	1 CHF 1 CHF 1 CHF No animal hairs	No Human 1 animal hairs	1 CHF 1 CHF No animal hairs	No Human 1 animal hairs
Findings after Washing #3	No Human 1 animal hairs	No Human 5 animal hairs	No Human 2 animal hairs	No Human 34 animal hairs	No Human 2 animal hairs	No Human 2 animal hairs	No Human 2 animal hairs	No Human 1 animal hairs	No Human 1 animal hairs	No Human 1 animal hairs	1 CHH 1 CHH No animal hairs
Findings after Washing #4	No Human 3 animal hairs	No Human 1 animal hairs	No Human 2 animal hairs	1 CBH 16 animal hairs	No Human 4 animal hairs	No Human 1 animal hairs	No Human 1 animal hairs	No Human 1 animal hairs	No Human 1 animal hairs	1 CHH 1 CHH No animal hairs	No Human 1 animal hairs
Findings after Washing #5	No Human 1 animal hairs	No Human 5 animal hairs	1 CHH 5 animal hairs	No Human 32 animal hairs	1 MHF 2 animal hairs	No Human 1 animal hairs	No Human 1 animal hairs	No Human 1 animal hairs	1 NHF 1 CHF 1 CHF No animal hairs	1 CHF 1 CHF No animal hairs	No Human 1 animal hairs
Findings after Washing #6	No Human 2 animal hairs	No Human 8 animal hairs	No Human 50 animal hairs	1 CHH 8 animal hairs	1 CHF 5 animal hairs	No Human 1 animal hairs	No Human 1 animal hairs	No Human 1 animal hairs	No Human 1 animal hairs	1 CHF 1 CHH 1 CHH No animal hairs	1 CHH 1 CHH No animal hairs
Findings after Washing #7	No Human 1 animal hairs	No Human 1 animal hairs	1 CHH 1 CHH 25 animal hairs	2 CHH 1 CHH 7 animal hairs	No Human 1 animal hairs	No Human 1 animal hairs	No Human 24 animal hairs	No Human 1 animal hairs	No Human 1 animal hairs	No Human 1 animal hairs	No Human 1 animal hairs
Findings after Washing #8	No Human 2 animal hairs	No Human 1 animal hairs	No Human 6 animal hairs	1 CHH 1 CHF 6 animal hairs	1 CHF 6 animal hairs	No Human 1 animal hairs	No Human 2 animal hairs	No Human 1 animal hairs	No Human 1 animal hairs	1 CBH 1 CHH No animal hairs	No Human 1 animal hairs
Findings after Washing #9	No Human 1 animal hairs	No Human 4 animal hairs	No Human 1 animal hairs	1 CHH 5 animal hairs	No Human 1 animal hairs	No Human 1 animal hairs	No Human 1 animal hairs	No Human 1 animal hairs	No Human 1 animal hairs	No Human 1 animal hairs	No Human 1 animal hairs
Findings after Washing #10	No Human 2 animal hairs	No Human 2 animal hairs	No Human 8 animal hairs	4 CHH 8 animal hairs	No Human 1 animal hairs	No Human 1 animal hairs	No Human 1 animal hairs	1 MHF 1 CHF No animal hairs	No Human 1 animal hairs	No Human 1 animal hairs	No Human 1 animal hairs

### Children’s Underwear

Column1	Household #1	Household #2	Household #3	Household #4	Household #5	Household #6	Household #7	Household #8	Household #9	Household #10	Household #11
Findings after Washing #1	No Human 2 animal hairs	No Human 9 animal hairs	No Human 2 animal hairs	1 CHH 1 CHH 1 CHF 14 animal hairs	No Human 3 animal hairs	No Human 1 animal hairs	2 CHH 8 animal hairs	1 MHF 1 MHF 1 MHF No animal hairs	No Human 1 animal hairs	No Human 1 animal hairs	No Human 1 animal hairs
Findings after Washing #2	No Human 3 animal hairs	No Human 2 animal hairs	No Human 4 animal hairs	1 CBH 8 animal hairs	1 NHF 2 animal hairs	No Human 1 animal hairs	No Human 1 animal hairs	No Human 1 animal hairs	No Human 1 animal hairs	No Human 1 animal hairs	No Human 1 animal hairs
Findings after Washing #3	No Human 1 animal hairs	No Human 1 animal hairs	No Human 9 animal hairs	1 CHF 5 animal hairs	No Human 1 animal hairs	No Human 1 animal hairs	No Human 1 animal hairs	No Human 1 animal hairs	No Human 1 animal hairs	No Human 1 animal hairs	No Human 1 animal hairs
Findings after Washing #4	No Human 1 animal hairs	No Human 1 animal hairs	No Human 1 animal hairs	No Human 1 animal hairs	No Human 4 animal hairs	No Human 1 animal hairs	No Human 1 animal hairs	No Human 1 animal hairs	No Human 1 animal hairs	No Human 1 animal hairs	No Human 1 animal hairs
Findings after Washing #5	No Human 1 animal hairs	No Human 5 animal hairs	No Human 3 animal hairs	No Human 5 animal hairs	No Human 1 animal hairs	No Human 1 animal hairs	No Human 1 animal hairs	No Human 1 animal hairs	No Human 1 animal hairs	1 CHH 1 CHH No animal hairs	No Human 1 animal hairs
Findings after Washing #6	No Human 1 animal hairs	No Human 1 animal hairs	No Human 3 animal hairs	1 CHH 2 animal hairs	No Human 1 animal hairs	No Human 1 animal hairs	1 MHF 1 animal hairs	No Human 1 animal hairs	No Human 1 animal hairs	No Human 1 animal hairs	No Human 1 animal hairs
Findings after Washing #7	No Human 2 animal hairs	No Human 1 animal hairs	No Human 1 animal hairs	1 dump of animal hairs	No Human 1 animal hairs	No Human 1 animal hairs	No Human 7 animal hairs	No Human 1 animal hairs	No Human 1 animal hairs	No Human 1 animal hairs	No Human 1 animal hairs
Findings after Washing #8	No Human 8 animal hairs	No Human 2 animal hairs	No Human 2 animal hairs	2 CHH 1 animal hairs	No Human 1 animal hairs	No Human 2 animal hairs	No Human 1 animal hairs	1 MHF 1 animal hairs	No Human 1 animal hairs	No Human 1 animal hairs	No Human 1 animal hairs
Findings after Washing #9	No Human 1 animal hairs	No Human 3 animal hairs	No Human 5 animal hairs	1 CHH 5 animal hairs	1 MHF 3 animal hairs	No Human 1 animal hairs	No Human 1 animal hairs	No Human 1 animal hairs	No Human 1 animal hairs	No Human 1 animal hairs	No Human 1 animal hairs
Findings after Washing #10	No Human 1 animal hairs	No Human 3 animal hairs	No Human 1 animal hairs	1 CHH 2 animal hairs	No Human 1 animal hairs	No Human 1 animal hairs	No Human 1 animal hairs	No Human 1 animal hairs	No Human 1 animal hairs	No Human 1 animal hairs	No Human 1 animal hairs

### MATERIALS AND METHODS

Packages of 100% cotton underwear were purchased. These included one each of women’s, men’s and girls’ underwear, see figure 1. The underwear was divided into sets consisting of one pair of each. Every pair of underwear given to be used in the study was examined by a forensic analyst in order to make sure that no hair was present from the manufacturing, packaging or shipping process. The sets of underwear were distributed to volunteers with the following instructions: take the underwear and come along it with your family’s regular laundry, handle these garments using your regular wash routine. Eleven different volunteer families were given sets of underwear. Families/ households were solicited volunteers. Efforts were made to try and obtain a broad demographic profile. The study was limited by the willingness of volunteers. The volunteers included 1 all Negroid family, 1 Caucasian/ 1 Caucasian/Negroid mix family, 1 all Mongoloid family, 2 Caucasian/ Mongoloid families and 5 all Caucasian families. One of the households did not own a washer and did the laundry at a commercial Laundromat.

Each set was laundered and returned. When returned, the set was examined by a forensic analyst for the presence of hair. If any hairs were found, they were removed, characterized, counted, documented and packaged. The goal was to get all of the volunteers through ten wash cycles. As these hair samples were not active casework and subject to either comparison or DNA, visually observed hairs were collected using tweezers. For the purposes of this study, damage that tweezers can do to hair structure was ignored.



Figure 1

Participant information	Washing Location	Washing Machine Style	Dried with Dryer	Number of Adults in the Household	Number of Children in the Household	Household Racial Summary
Household #1	Home	Toploader	Yes	3	0	3C
Household #2	Laundromat	Toploader	Yes	2	1	3C
Household #3	Home	Toploader	Yes	2	1	1C 2M/C
Household #4	Home	Toploader	Yes	1	0	1C
Household #5	Home	Toploader	Yes	3	1	3C 1N/C
Household #6	Home	Toploader	Yes	1	0	1C
Household #7	Home	Toploader	Yes	2	0	1C 1M/C
Household #8	Home	Toploader	Yes	2	0	2M
Household #9	Home	Toploader	Yes	4	0	4N
Household #10	Home	Toploader	Yes	2	0	2C
Household #11	Home	Toploader	Yes	2	0	2C

### CONCLUSIONS

Our results illustrate that there is some potential for detecting human hair on underpants that have been laundered with another individual’s clothing even in the absence of person to person contact. Hair can be transferred via routine clothing laundering events. This is an important consideration in cases where the victim and the suspect cohabit and have clothing laundered together.

A review of the data suggests that whether or not human hairs and fragments are transferred in the laundry is very dependent on the household. The facts and history of the case needs to be a consideration in evaluating the usefulness of finding hair on underwear. One household had no instances of human hairs or fragments found while one household had hairs or fragments found on 21 of 30 samples. Only one household had human hairs or fragments found on more than half of the items. The finding of human hair did in most cases correlate with the animal hair findings for these households. This would suggest that the finding of animal hair may be an indication of the effectiveness of the individual washing machine.

The household where the laundry was done at a Laundromat did not differ from the households where the items were laundered at home. In two of the households where multiple races were represented, the hairs and fragments found represented those races. In the other household with multiple races, perhaps some of the hairs classified as Caucasian head hairs were actually from one of the Mongoloid/ Caucasian members of the household. The Caucasian member of that household shaves his head and is completely bald. (Note: This suggested that how a hair was characterized regarding race does not necessarily always represent how that person would classify himself/herself, a possible topic for further investigation.) Household 8 classified themselves as Mongoloid, specifically “South Asian,” while most of the hairs found exhibited mixed racial characteristics. Two other trends were observed. There were more instances of hairs found on the men’s underwear than the women’s or children’s underwear. Perhaps the thread count is a factor. The thread count in the men’s underwear was 16X19 versus 19X28 for the women’s and 18X26 for the children’s underwear. In general there was more hair transferred after the first washing than subsequent

washings, 14 of 33 samples. The number of hairs and fragments dropped significantly after wash 1 except for wash 5 where 12 of 33 samples contained hairs or fragments.

The probative value of items, including underwear from a victim, may be diminished due to the fact that there is a potential for transfer from laundering clothes together. In this study human hairs or fragments were found on the garments in 82 of the 321 washings. However, only one pubic hair was found in all of the 321 washings. In normal sexual assault cases processed through this lab, one or two pubic hairs may be found on victim’s underwear. This study indicates that though it is possible that pubic hair recovered from underwear could come from the laundry, it is more likely that head hairs could come from the laundry.

### ABBREVIATIONS

C= Caucasian M=Mongoloid Mx=Mixed Racial Characteristics  
N=Negroid HH=Head Hair BH=Body Hair PH=Pubic hair

### REFERENCES

- Nickell, J, Fischer John F., (1999) *Crime Science: Methods of Forensic Detection*. University of Kentucky Press. Lexington Kentucky
- Forensic Science Communications, April 2005, Vol. 7, No. 2.
- Finkelhor, D., & Dziuba-Leatherman, J. (1994). Children as Victims of Violence: A National Survey. *Pediatrics*, 94 (4), 413-420. Timnick, L. (August 15, 1985).
- The Times poll: Twenty-two percent in survey were child abuse victims. *Los Angeles Times*, p. 1.
- Hanson, R. F., Resnick H. S., Saunders, B. E., Kilpatrick, D. G., & Best, C. (1999). Factors related to the reporting of childhood rape. *Child Abuse & Neglect*, 23, 559-69.
- Bisbing, Richard E., (1999) *Trace Evidence*, in *Mute Witnesses: Trace Evidence Analysis*, Houck, Max, (ed.) Academic Press, San Diego, California.