

Scalp hair length. II. Estimating the percentages of adults in the USA and larger populations by hair length

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Synopsis

Scalp hair length assessments by anatomical site, previously made in Florida theme parks on adults (1), are related to anatomical measurements to obtain estimates of free-hanging hair lengths in centimeters. A plot of the natural logarithm of the percent population versus these hair lengths provides a straight line and an equation that permits the estimation of the numbers of persons in the USA and larger populations with hair lengths up to 183 cm (just beyond ankle-length). Data were also collected via a literature search for even longer hair lengths (ankle-length or longer) to provide an equation to estimate the numbers of persons with exceptionally long hair. A comparative plot of these two equations suggests that “normal” anagen periods may be considerably longer than current estimates in the literature.

INTRODUCTION

In this paper, an attempt is made to estimate the percentages of persons in the USA and larger populations with different lengths of long hair, up to abnormally long scalp hair. This is an onerous task involving many assumptions, but we believe the data covering up to at least 183 cm (six feet) for the United States of America (USA) are relatively good approximations and that the percentage estimates for longer hair for the developed world based on the cited assumptions are also satisfactory.

In a previous paper, hair length studies at four different theme parks in central Florida were described and used to estimate the percentages of persons in the USA with different lengths of scalp hair corresponding to different parts of the anatomy, e.g., the shoulders, the shoulder blades, the waist, and the buttocks (1). In the current work, the anatomical positions are related to anatomical measurements in order to estimate hair lengths from equations relating these anatomical measurements to the percentages for the populations of the USA, the developed world, and a population equal to that of the entire world.

RESULTS AND DISCUSSION

POPULATION

The population on which these data are based is, strictly speaking, the population that

attends theme parks in Florida or in the USA. Several attempts were made to contact the Walt Disney Corporation to obtain information on that population. Those contacted refused to provide any information, indicating that such was proprietary. As indicated in Part I, the hair-length data were found to be from the same population (with regard to hair length) among all the different theme parks. Furthermore, comparison of the data to that from a 1972 hair-length market research survey in the USA among females ages 14 to 60 (geographically dispersed across the entire USA) indicated good agreement between the shoulder-length assessments (26.3% versus 24%).

Table I shows a more complete comparison, with newer data, from only 601 females from the MGM Studio theme park, done in late 2000, evaluating short (chin-length), medium (chin-to-shoulder-length) and long (shoulder-length or longer) hair only. These data show reasonably good agreement. However, the theme park study shows a lower percentage of women with short hair (29% to 33%) and a larger percentage with long hair (30% to 24%).

These differences could be due to either different populations, or to a change in hairstyles and hair-cutting practices for the more recent study, but are partly due to the small sample size of this study, because the sum of all the theme park data versus this USA study shows 26.3% versus 24% for the shoulder-length data (see Table I). It is our conclusion that the theme park study does provide a reasonable approximation for hair-length populations in the USA. The percentages provided by our theme park data most likely represent the mid-teenage group up to people in their mid-60s. We excluded those with an estimated height of less than 4.5 feet, and although many people age 60 and older attend theme parks, fewer people from this older age group attend theme parks than are in the general population of the USA. Therefore, the theme park data is more likely representative of the age group 15 to 60 than of the entire population, and so these data most likely provide slightly higher percentages for the long-hair groups than for the overall USA population.

Additional calculations are provided to approximate hair length for the developed world (defined in Table II) and for the entire world. It is our conclusion that the estimates for the developed world will be better approximations than for the entire world because the age groups for the developed world are closer to those of the USA and of the theme park attendees and because the hair cutting practices will also be more similar (see Table II).

ANATOMICAL POSITIONS AND HAIR LENGTH

An important step in our current effort was to relate these anatomical positions (Table

Table I
Hair Length From Theme Parks Versus a 1972 USA Study

Hair length	Percentage		
	1972 USA study*	MGM study on women**	All theme park studies***
Chin or shorter	33	29	—
Chin-to-shoulder	43	41	—
Shoulder or longer	24	30	26.3

* N = 15,000 women ages 14 to 60.

** N = 601 women, MGM Studios theme park.

*** N = 12,150 women, several Florida theme parks.

Table II
Percentage of Different Populations by Age*

Age group	USA	Developed world**	Entire world
Under 15	21	18	32
15 to 60	63	63	58
60 and over	16	19	10

* Calculated from data of the United Nations Statistics Division (2).

** Consists of 43 countries including the USA, most of Europe, Japan, the Russian Federation and adjoining countries, and Australia, and represents 20% of the world's population.

III, Figure 1) to anatomical measurements so that we might estimate the actual hair lengths of these populations. Some of the data from our former paper is provided in Table III along with calculations to estimate the percentages of people with hair lengths between the limits of every two anatomical sites.

To relate the anatomical positions to actual hair lengths, six people were measured (three females and three males), ranging in height from 158 cm to 191 cm (5'2" to 6'3") (see Table IV). Measurements were actually taken with a tape measure made in the USA based on the English system (inches) and then converted to centimeters by multiplying by 2.54. Two sites were taken on the head to measure from, one near the frontal area, indicated as A, and the other representing the crown area, marked B in Figure 1. The distance from the frontal area to the crown averaged 12.7 cm. Measurements made from the crown to the anatomical positions are listed in Figure 1, and these were converted to hair lengths in centimeters (see Table IV). The data from Table IV allow estimates from both the crown area and the frontal area to the anatomical sites. Total ranges and midpoints are listed for each anatomical site in Table V.

For the hair-length calculations in this paper, the approximate midpoints for the anatomical sites were used. These actually represent the free-hanging lengths rather than the actual lengths. The actual lengths of the hair when pulled taut will always be longer than the free-hanging lengths because of hair curvature (see footnote in Table IV).

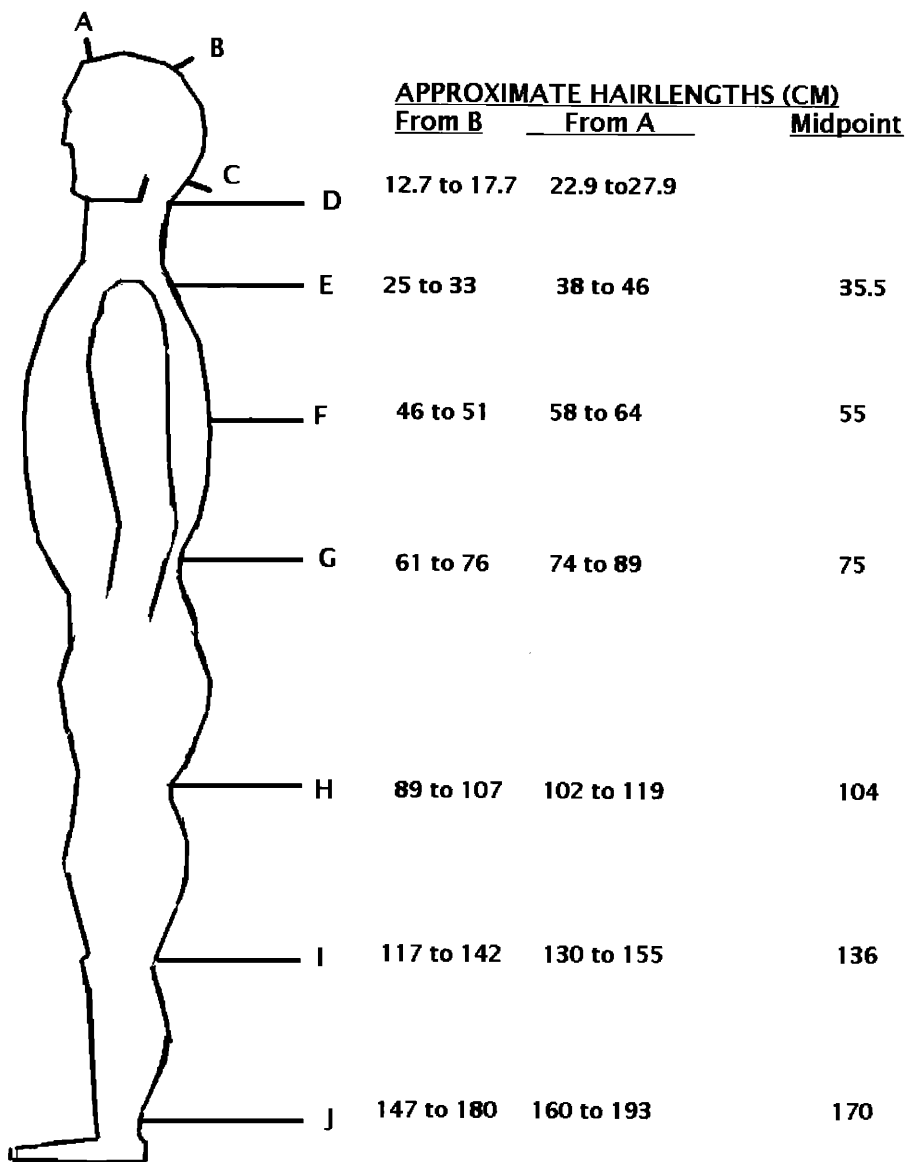
The midpoints from the ranges of these measurements (Table V) were then used with the data from the theme parks, i.e., the percentage of persons between the anatomical sites (Table III) along with additional data for subsequent treatment and conclusions.

Table III
Hair Length and the Percentage of Persons From Study of 24,300 Persons (11)*

Anatomical position	% At site or longer	% Between sites**
Shoulder-length or longer	13.20	
Between shoulder and lower shoulder blade		10.77
Lower shoulder blade or longer	2.43	
Between lower shoulder blade and waist		2.11
Waist-length or longer	0.317	
Between waist and buttocks		0.301
Buttocks-length	0.0165	

* Males plus females

** The actual data are percentages at the site or longer. Subtracting the numbers for the longer lengths permits calculation of the percentages between sites.



A = Frontal; B = Crown; C = Occipital; D = Chin; E = Shoulder; F = Lower shoulder blade; G = Waist; H = Buttocks; I = Knee and J = Ankle.

The distances from A to B and B to C are 10.2 and 12.7 cm plus or minus 1.

Figure 1. Measurements of anatomical positions relating to free-hanging hair lengths.

CALCULATIONS (ESTIMATES) FOR THE USA AND LARGER POPULATIONS

Four data points from the theme park studies expressed as hair lengths based on the anatomical site measurements (Table V—Approximate midpoints) were plotted against the natural logarithm of the percentage of the population between sites (Table III), providing the graph in Figure 2. This represents the use of 3,208 data points rather than the total of 24,300 from our theme park studies. The equation representing this straight

Table IV
Anatomical Measurements (cm) From Crown of Six Panelists*

	Sex						Avge	Range
	F	F	F	M	M	M		
Height	163	170	158	191	178	185	174	158 to 191
Shoulders	25.4	27.9	27.9	30.5	30.5	33	29.2	25.4 to 33
Bottom shoulder blades	45.7	48.3	45.7	45.7	48.3	50.8	47.4	45.7 to 50.8
Waist	61	63.5	61	73.7	68.6	76.2	67.3	61 to 76.2
Buttocks	91.4	94	88.9	101.6	104.1	106.7	97.8	88.9 to 106.7
Knees	119.4	124.5	116.8	142.2	132	134.6	128.3	116.8 to 142.2
Ankles	152.4	160	147.3	180.3	170.2	172.7	163.8	147.3 to 180.3

* From frontal area add 12.7 cm. The actual length of the hair pulled taut will always be longer than the above measurements; the difference depends on the amount of curvature in the hair. Assume about a 5% additional length for taut hair, although it will be longer than 5% if the hair is very curly or if it is braided. If the hair is very straight, the taut length may be less than an additional 5%.

Table V
Anatomical Sites and Approximate Hair Length Rounded Off to Nearest Centimeter

	From B	From A	Approximate range	Approximate midpoint*	Approximate midpoint + 5%**
Shoulder-length	25 to 33	35 to 43	25 to 43	34 ± 9	36 ± 9
Lower-shoulder-blade-length	46 to 51	56 to 61	46 to 61	53.5 ± 8	56 ± 8
Waist-length	61 to 76	71 to 86	61 to 86	73.5 ± 15	77 ± 15
Buttocks-length	89 to 107	99 to 117	89 to 117	103 ± 14	108 ± 14
Knee-length	117 to 142	127 to 152	117 to 152	134.5 ± 18	141 ± 18
Ankle-length	147 to 180	157 to 190	147 to 190	168.5 ± 22	177 ± 22

A is the frontal area, and B represents the crown area. A = B + 10.2 cm (4 inches).

* Represents the approximate length of hair as it hangs free from the midscalp.

** Approximates the taut length of hair from the midscalp. See explanation in Table V.

line (A) was used to estimate the approximate numbers of people in the USA at several hair lengths within and beyond the limits of the graph:

$$Y = 5.693 - 0.0945X \tag{A}$$

Y = ln% of population, and X = hair length in centimeters. R² = 0.998 and is highly significant.

For all calculations from this equation, one should use either the average lengths from the anatomical sites of Table IV or if other individual lengths are used, one should choose lengths at least as far apart as the plus or minus values for the averages listed in Table IV; otherwise the added percentages will exceed 100%.

Extrapolation of this line, Figure 2, permits us to estimate percentages and numbers of people in the USA with even longer hair lengths. We used 183 cm (six feet) as the cutoff point for extrapolation, based on information provided by Figure 3 and described later in this paper.

In the theme park studies, no person was observed with hair longer than buttocks-length. However, hair much longer than that exists and has been reported from many different sources (3–8). Hair down to the ankles has been observed for many persons, including the beautiful hair of the entertainer Crystal Gayle (see Figure 4). Equation A

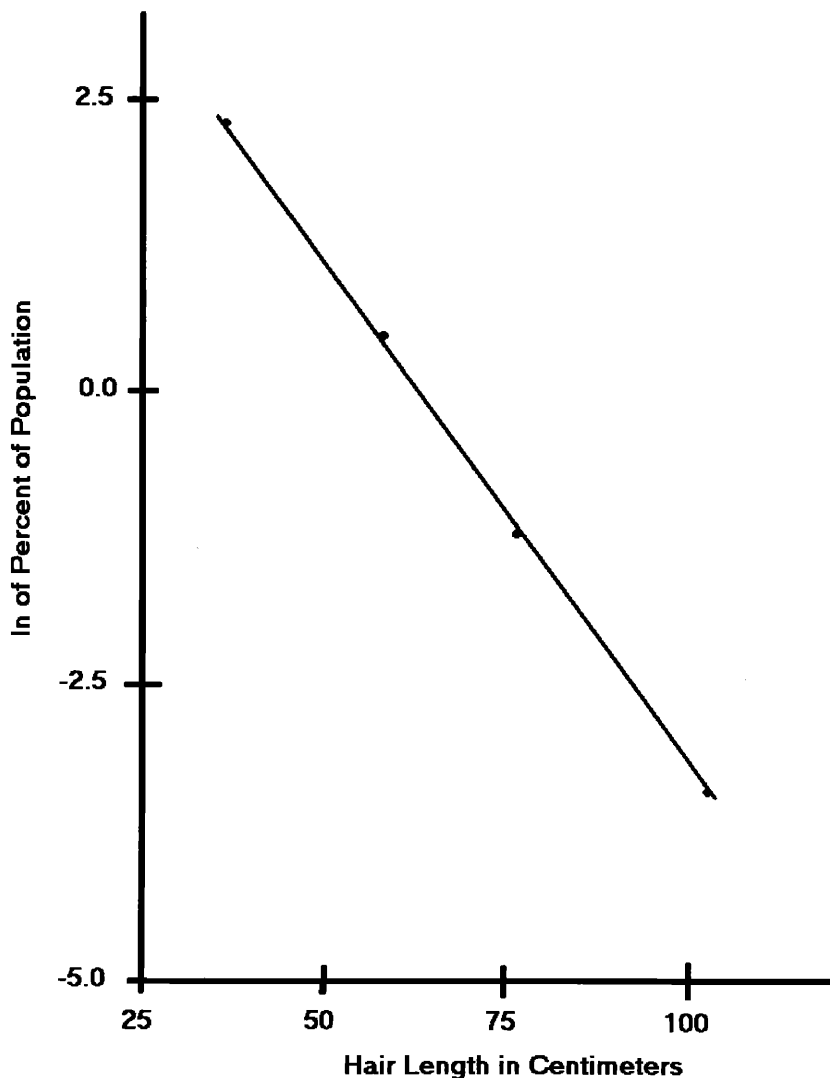


Figure 2. Plot of the natural logarithm of the percentage of the population versus hair length (in centimeters).

suggests that $9.6 \times 10^{-6}\%$ of the population has hair 183 cm long), or about 21 people in the USA, and that about 73 people in the USA have hair that reaches to their ankles (free-hanging length of approximately 168 ± 22 cm) (see Table VI). Therefore, a literature search was conducted to try to obtain an indication of the relative numbers of people known to have hair ankle-length or longer (free-hanging lengths of approximately 168 ± 22 cm and longer).

Table VII provides a summary of persons with very long hair, and that hair has been categorized into three groups by length. Among the sources for this tabulation are the *Guinness Book of World Records* from 1996 and 1999 (5,6), and a long-hair website by Frank Pflonissen (7). Other sources are an internet article by Sutin Wannabovorn (8)

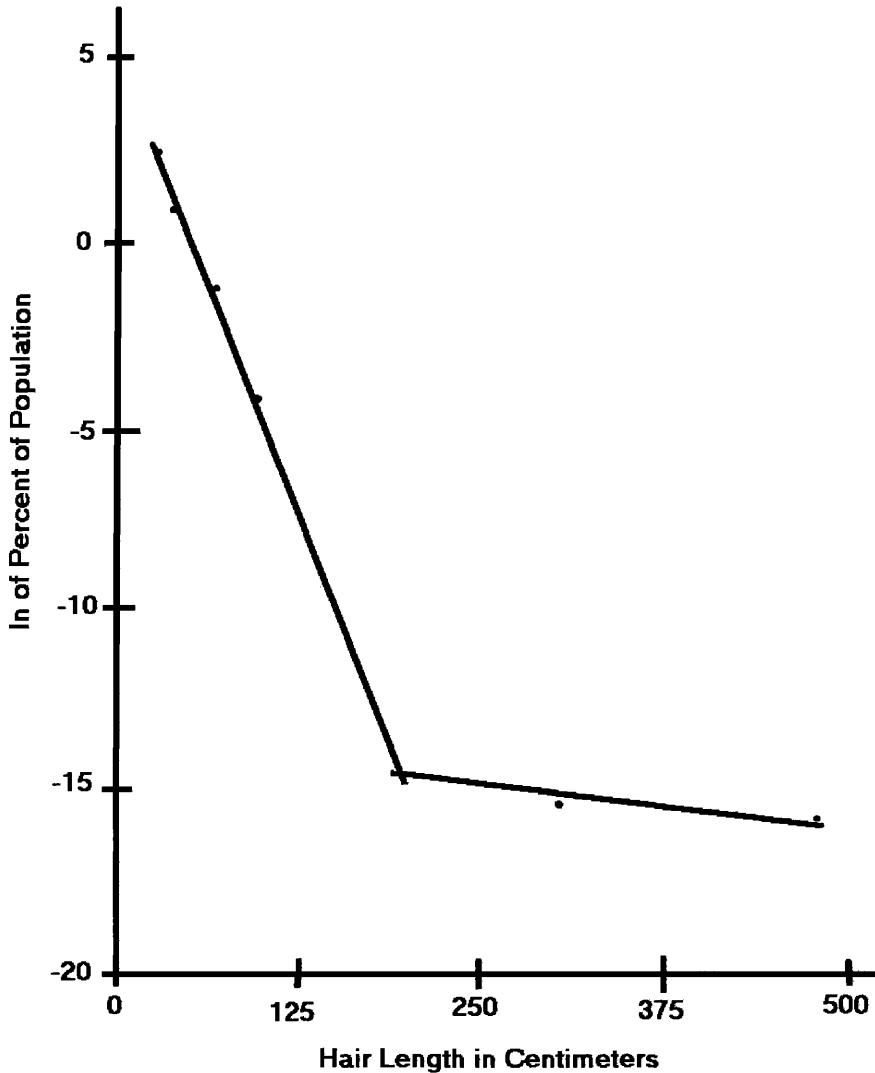


Figure 3. Plot of the natural logarithm of the percentage of the population versus hair length up to currently documented hair lengths (in centimeters).

about Lu Seng La, touted by Ripley's as possessor of the world's longest hair, and an internet article from the Godrej Hair Care Institute (9) about Diane Witt. The focus of the tabulated data are primarily from the past ten years rather than older data, which were purposely excluded.

These longer hair lengths from the literature (183 cm [six feet] and longer) come from people from all over the world. Therefore, percentages were calculated based on the number of people at that hair length relative to the world's population of 6 billion people, assuming 4.5 billion as adults, since 75% of the world's population are age 12 and above (10) (see Table VI). As our discussion and data below show, there undoubtedly are more people in the world with hair length between 183 cm and 518 cm (between

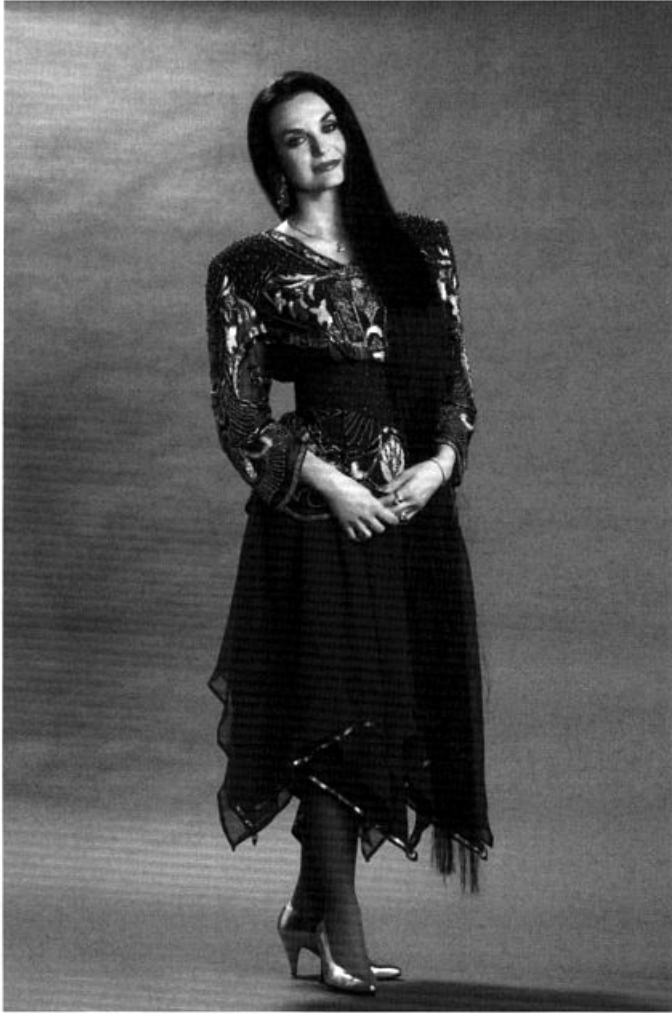


Figure 4. The long hair of Crystal Gayle. Hair to the ankles can be observed in only a small percentage of the population. (Published with permission of Gayle Enterprises, Inc.)

six and 17 feet) than listed in these websites, but we believe that our discussion below shows that our primary conclusions will not change appreciably even if there are more persons with hair between these lengths.

Figure 3 is a plot made by combining the data on hair length from our USA theme park studies with the data of Table VII. In this graph, we assume that the USA data (percentages) represent data for the whole world. For the developed world this assumption probably holds reasonably well. However, for developing-world countries like India, China, and Indonesia, with a higher percentage of very young people (Table II) and where there is less cutting of hair, especially among females, this assumption will likely provide low estimates.

Obviously, this assumption provides greater deviation at shorter hair lengths because of the limits imposed by common anagen growth periods, usually cited at two to six years

Table VI
Calculations From the Data on Hair Length in USA and Larger Populations*

% Population (site)	Hair length (cm)	Number of persons (calculated from equations A and B)**
12.04 (shoulder)	34	26.6 million USA; 118 million developed world
1.88 (shoulder blade)	53.5	4.2 million USA; 18.6 million developed world
0.281 (waist)	73.5	620,000 USA; 2.75 million developed world
1.78×10^{-2} (buttocks)	103	39,300 USA; 175,000 developed world
8.45×10^{-4} (knees)	134.5	1,900 USA; 8,400 developed world
3.3×10^{-5} (ankles)	168.5	73 USA; 324 developed world; 1,500 world
9.6×10^{-6}	183	21 USA; 93 developed world; 400 world
1.5×10^{-7}	305	0 USA; 1 developed world; 7 world
6.0×10^{-8}	488	0 USA and developed world; 3 world

* Population of USA = 270 million, but since approximately 82 percent of the USA population (15) are age 12 and above, use 221 million as the adult population for the USA. Since approximately 75 percent of the world's population (10) are 12 and above, use 4.5 billion as the adult population of the world.

** Numbers rounded off, except where fewer than 100.

(11,12) or at about 25 to 76 cm (10 to 30 inches) in hair length (assuming a growth rate of 12.7 cm (five inches) per year) (13,14). As suggested above, the three graphical points (Figure 3) from the literature, for the very longest hair, most likely do not contain all the people in the world with those lengths of hair, making the number of people and our calculated percentages low for the very longest hair (beyond 183 cm). The difference between this literature value at 183 cm ($2.9 \times 10^{-7}\%$) versus the point obtained by extrapolation of the line in Figure 2 ($96 \times 10^{-7}\%$) differs by a factor of about 33, further suggesting that this conclusion (percentages from these literature values are low) is true.

In the graph represented by Figure 3, two straight lines are formed intersecting at about 183 cm. The two very different slopes suggest a different mechanism or explanation for maximum hair lengths from 34 to 183 cm versus 183 to 488 cm. The equation describing the latter three points of this line from the literature data is:

$$Y = -14.266 - 0.00473X \quad (B)$$

The data point at 183-cm hair length (from the literature) is close enough graphically to the point from the USA hair study (by extrapolation from equation A) to suggest that at least on a relative basis our assumptions are reasonable approximations.

Nevertheless, the point at 183-cm length provides very different values for calculating the percentage and numbers of people at 183-cm length, i.e., two people in the USA from equation B versus 21 people from equation A, differing by a factor of about 10. We believe that the higher value from equation A is closer to the actual value, and we use that value in Table VI. The region and slope from 35 cm to 183 cm (one to six feet) hair length appears to be governed by a "normal" anagen to catagen to telogen transition, suggesting a normal anagen period of up to as long as 12 to 14 years. This is a different view from the past belief of about a six-year anagen period approaching the "normal" upper limit. Anagen periods are frequently cited as two to six years and several weeks for catagen and telogen; however, few have actually attempted to measure anagen time periods and only on small populations (11,12). In addition, longer anagen periods than six years have been cited (11). As indicated, the slope in the longer-hair-length region (183-to-488 cm) might suggest a different mechanism to control this extra-long anagen

Table VII
Very Long Hair From the Literature

Hair length	No. of persons and source
488 cm ± 91 cm (16' ± 3')	<u>Three persons (4,5)</u> Mata Jagdamba of India, 423 cm; Hoo Sateow, 513 cm, and his brother, 493 cm (Thailand)
305 cm ± 91 cm (10' ± 3')	<u>Six persons</u> Diane Witt USA (1988) 244 cm (8); (1992) 305 cm (8); (2000) 386 cm (8) Georgia Sebrantke, 301 cm (6) Wang Li Juan, China; estimate from photo, 244 cm (6) Dyq, China; estimate from photo, 274 cm (6) Lu Seng La, Thailand, 387 cm (6) Hiroko Yamazaki, Japan, 231 cm (6)
183 cm ± 30 cm (6' ± 1')	<u>Thirteen persons</u> Jin Weiqun, China, 183–213 cm, estimate (6) Irena Godyn, USA, 193 cm (6) Cindy Christian, 188 cm (6) Tien Chun Mei, China, ~183 cm, estimate (6) Xu Huiqin, China, 175 cm (6) Sabine, Germany, 173 cm (6) Darla, USA, 153–183 cm, estimate (6) Alla Bokareva, Russia, 165 cm (6) Dhorie Geronimo, 165 cm (6) Susanne Kalb, 165 cm (6) Yi Tao La, Thailand, 165 cm (7) Suzy, Florida, USA, >153 cm, estimate (6) Crystal Gayle, USA, 153 cm (6)

period, but more likely it involves a defect in the mechanism to terminate anagen and to provide for the transition to catagen and telogen.

If this same slope from equation A (35-to-183 cm) is extrapolated to represent one person in 4.5 billion (current “adult” world population), it provides a maximum hair length of about 247 cm. The simple fact that there are three people in the world today with hair nearly twice that length (see Table VII) confirms that a change in slope is necessary to account for these people with the abnormal hair growth condition causing scalp hair lengths greater than 183 cm.

As indicated earlier, equation A permits one to estimate the percentage and numbers of people in the USA with hair of any length between 35 and 183 cm (see Table VI). For the developed world, the USA numbers were simply multiplied by 4.44, the factor between the USA population and that of the developed world (2,10). We estimate about 1,500 people in the world with hair down to their ankles, and about 324 people in the developed world with hair of that length, but only about 73 people in the USA with ankle-length hair. On the other hand, this equation suggests approximately 1,900 people in the USA have hair reaching to their knees, but more than 8,000 in the developed world and more than five times the developed-world number for the entire world.

For estimating the numbers of people in the world with hair lengths longer than 183 cm

(Table VI) we used equation B. As indicated above, the estimates for the numbers of people provided by this equation are most likely low since the data used to derive the equation are from Table VII and are only from long-haired persons identified and measured over the time frame in the sources indicated.

OTHER SOURCES

Several decades ago, the Guinness group reported, "The longest recorded hair (scalp) was that of Swami Pandarasannadhi of the Thiruvadu Thurai monastery, India. His hair was reported in 1949 to be 792 cm (26 feet) in length" (2). The Guinness group continued, for three decades, to report the Swami as having the world's longest hair, but later (4) added the qualifying detail, "From photographs it appears that he was afflicted with the disease *Plica caudiformis*" (4). This is a disease of the scalp causing the hair to be matted and crusted, with the fibers "glued" together, appearing to form one single thick club like the tail of a horse. Later, in 1990 and 1991, the Guinness group indicated that, "no photographic or scientific evidence has ever been supplied in order to support this extreme measurement," for the hair of the Swami.

Equation B indicates approximately one person in 6.7 billion for scalp hair at 792 cm in length. Considering that this number (6.7 B) is approximately 1.5 times the current world adult population, the hair length of 792 cm is a remote possibility. However, Carl Haub of the Population Reference Bureau in Washington estimates "105 billion births since the dawn of the human race" (16), and he feels that his assumptions of constant population growth during different periods, especially in the earlier periods, most likely leads to an underestimate rather than an overestimate. Of course, the practice of cutting hair also decreased dramatically in earlier years; however, this factor would be balanced by a decrease in longevity in earlier years. Therefore, a scalp hair length of 792 cm since the beginning of time is a possibility. However, it is not surprising that that length has not been documented.

In 1988 and 1990 the *Guinness Book of World Records* listed Diane Witt (9) as having the world's longest hair, and then Mata Jagdamba was measured on February 21, 1994 (5), followed later (1999) by Hu Saelao (Hoo Sateow), a tribal medicine man of Chiang Mai, Thailand, as having the longest scalp hair. At that time Hu was 85 years old. His hair measured 5.15 meters (16 feet, 10 inches) in 1999 (6), and he was reported to have not cut it for 70 years. According to the Guinness website (www.guinnessworldrecords.com), Hu washes his hair annually in detergent and wears it wound up in a "beehive" hairstyle. From photographs, he appears bald in the frontal area and his extensive growth of hair appears to be primarily from the rear portion of the scalp. Hu's brother also has hair nearly 5 meters long. Our literature search revealed three people today with hair near that length.

The following facts on beard and mustache length, although not specifically relevant to this article, are listed for the interested reader. The longest beard on record was that of Hans N. Langseth of Norway, who was born in 1846 and died in the USA in 1927 (6). According to Guinness, at the time of his death in 1927, his beard measured 533.4 cm (17.5 feet) in length. It was presented to the Smithsonian Institute in Washington, DC, in 1967. The Guinness source lists the beard of Janice Deverse of Bracken County,

Kentucky, measured at 35.6 cm (14 inches) in 1884 as the longest recorded beard for a woman (6).

The longest mustache on record was that of Kalyan Ramji Sain of Sundargarh, India, with a span of 339 cm (133.5 inches) and a length of 172 cm (67³/₄ inches) on the right side and 167 cm (65³/₄ inches) on the left side, measured in July of 1993 (6).

SUMMARY AND CONCLUSIONS

Hair length estimates by anatomical site, previously made in Florida theme parks on "adults," are related to anatomical measurements to obtain estimates of actual free-hanging hair lengths in centimeters. A plot of the natural logarithm of the percent population versus these hair lengths provides a straight line. The equation of this line permits the estimation of the numbers of persons in the USA and the developed world with hair lengths up to about 183 cm (just beyond ankle-length). Data were also collected via a literature search for even longer hair lengths (ankle-length or longer) to provide an equation to estimate the numbers of persons with exceptionally long hair. A plot of these two equations together suggests that "normal" anagen periods may be considerably longer than current estimates in the literature.

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