***Paper presented at the WPATH 20th International Symposium, Chicago, Illinois, September 5-8, 2007. Submitted for publication in the *International Journal of Transgenderism* (IJT).

On the Calculation of the Prevalence of Transsexualism

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September 6, 2007***

Abstract:

The most-cited estimates of the prevalence of transsexualism are based on counts of gender reassignments in European clinics many years ago. Observing that reassignments have been in a 'start-up transient', we extend those results by recalculating prevalence from the accumulating incidence data, taking into account birth, reassignment and death rates – and then, based on age-distributions of reassignment data, we determine the inherent number of persons who at some point in life will undergo reassignment. From this reanalysis of those early reports, we determine lower-bounds on the prevalence of the underlying condition of transsexualism to be between 1:1000 and 1:2000, using those reports' own data. We then present more recent incidence data and alternative methods for estimating the prevalence of transsexualism, all of which indicate that the lower bound on the prevalence of transsexualism is at least 1:500, and possibly higher.

Keywords: Transsexualism, prevalence, gender reassignment, transgender, transition.

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1. Introduction:

In past years, the most-cited estimates of the prevalence of transsexualism have been based on counts of people who have undergone gender reassignment (usually involving SRS) under the care of certain clinics in Sweden, the Netherlands and a few other European countries. Lower bounds for prevalence were then determined by dividing the reassignment counts by the relevant population numbers.

In this paper, we discuss these past reports and the methods they used. As we proceed, we develop definitions, notation and mathematical methods that enable us to explore and analyze the data in those reports in new ways – and extract further results from them.

We were motivated to undertake this investigation by the findings of convincing evidence in 2001 [Conway01] that the prevalence of transsexualism is far, far greater than that reported in earlier studies. Wondering what had happened led us to delve into the details of that earlier work.

Noting that the incidence of gender reassignment in many countries has been in a “start-up transient” of gradual increases over the years, we extended the estimates of the earlier studies using mathematical analyses to determine prevalence from the accumulating incidence data in those studies - taking into account birth, reassignment and death rates.

We then developed a mathematical method for estimating the latent and inherent numbers of people who will at some point during their lives undergo sex reassignment surgery (SRS), based on the ongoing incidence of SRS and the age-distribution of the occurrences of SRS.

The above mathematical methods were then applied to making refinements and extensions of the results of past reports on the prevalence of SRS, with detailed examples developed on how to do this. From this reanalysis of those early reports, we determined lower-bounds on the prevalence of the underlying condition of transsexualism to be between 1:1000 and 1:2000, using those reports’ own data. We then explored and now present more recent incidence data and alternative methods for estimating the prevalence of transsexualism, all of which indicate that the lower bound on the prevalence of transsexualism is at least 1:500, and possibly higher.

These findings have major implications for WPATH and the medical community, since many of the challenges and problems involved in providing for the health and well-being of transgender and transsexual people are directly proportional to their inherent numbers.

2. Oft-cited Reports on the Prevalence of Transsexualism:

In this section, we discuss a sequence of oft-cited reports on the prevalence of transsexualism, and begin an analyses to extend the results of those reports ([Wålinder68], [Hoenig74], [Eklund88], [Tsoi88], [Bakker93], [VanKesteren96], [Weitze96], [DeCuypere06]).

Although most of the included reports use the same definition of transsexualism, and make counts and calculations in similar ways, we find in this section that a gradual shift has occurred down through the years in what is being counted - leading to incommensurability of reported results across the overall set of studies [Conway07]. The nature of this shift can be made visible by using notation that clarifies what is being counted.

See [Conway07] for detailed commentaries on and cross-comparisons of these and additional past studies, such as [Wålinder71], [Ross81], [Wilson99], [Conway01], [Kelly01], [Winter02], [Winter06]. That report also includes methods for normalizing results to ensure commensurability, and tabulations of normalized results across the larger set of reports.

Wålinder 68:

In the first systematic study of its kind, [Wålinder68] surveyed Swedish psychiatrists to determine how many people had approached them seeking a “sex change”. By dividing those numbers by the relevant populations (over age 15), the reports finds that the “minimum total of transsexuals in Sweden on Dec. 31, 1965” was “according to sex, 1:37,000 men and 1:103,000 women.” (i.e., 1 in 37,000 persons born as males and 1 in 103,000 persons born as females) Using the notation, P(TSmf) for the “prevalence of mf transsexualism”, we might be tempted to present Wålinder’s results as follows

P(TSmf) [Wålinder68] = 1:37,000
P(TSfm) [Wålinder68] = 1:103,000

However, [Wålinder68] discussed many difficulties involved in making such prevalence estimations, noting (i) the difficulties in defining the condition, (ii) the small samples available, (iii) the fact that available treatments were fairly recent compared to the average lifespan, and (iv) the difficulty of gathering data due to the fact that many transsexual people had not yet found their way into treatment.

[Wålinder68] also presented a list of indicators of transsexualism, and that list is referred to in many later prevalence studies as “Wålinder’s definition of transsexualism”:

1. A sense of belonging to the opposite sex, of having been born into the wrong sex, of being one of nature’s extant errors.
2. A sense of estrangement with one’s own body; all indications of sex differentiation are considered as afflictions and repugnant.
3. A strong desire to resemble physically the opposite sex via therapy including surgery.
4. A desire to be accepted in the community as belonging to the opposite sex.

Wålinder’s definition gradually became a de-facto definition of transsexualism in the research literature, and, as we will see, it was adopted as such by most of the later prevalence studies. Because of this, we use it in our analyses and cross-comparisons of those later studies. Wålinder’s definition is a workable one for our purposes here, being very close to modern efforts at defining transsexualism, such as in the WHO ICD-10:

> *“Transsexualism: A desire to live and be accepted as a member of the opposite sex, usually accompanied by a sense of discomfort with, or inappropriateness of, one's anatomic sex, and a wish to have surgery and hormonal treatment to make one's body as congruent as possible with one's preferred sex.”* [WHO07a]

It is most important to note that Wålinder’s definition refers to the <u>inherent condition</u> of transsexualism as a percept, rather than the condition of having actively sought help, much less having undergone treatment to resolve the inherent condition. Wålinder thus implicitly indicated that his prevalence numbers should be interpreted as “minimums” (i.e., as “lower bounds”), in part because they only counted those who had already sought help.

Since Wålinder was not reporting the prevalence of transsexualism under his definition, but instead reporting the prevalence of those seeking help, we denote his results as follows:

P(SHmf) [Wålinder68] = 1:37,000
P(SHfm) [Wålinder68] = 1:103,000

Hoenig74:

In 1974, [Hoenig74] presents results of a later, similar study in the Manchester region of the UK. The study followed the [Wålinder68] definition of transsexualism, and made counts of people who sought help at a gender clinic in a particular geographical unit of the UK medical system. As in [Wålinder68], this report used only people over the age of 15 for relevant populations (and this became the tradition of almost all later reports on prevalence). The reported prevalence values are as follows (and again are for those seeking help), and are rather coincidentally close to those of [Wålinder68]:

P(SHmf) [Hoenig74] = 1:34,000

P(SHfm) [Hoenig74] = 1:108,000

Note: It may be that, because of the closeness of these results to [Wålinder68], the roughly rounded-off numbers of 1:30,000 and 1:100,000 came to be widely cited by psychiatrists as definitive values for the prevalence of mf and fm transsexualism, even though both [Wålinder68] and [Hoenig74] presented their results as "minimums" (i.e., as lower bounds) [Conway07].

Elklund88:

Using Wålinder's definition, [Elklund88] counted the accumulating numbers of people at the AZVU clinic in Amsterdam who had been 'diagnosed' as transsexual and had received hormone treatment there as of 1980, 1983 and 1986. These numbers were then divided by the relevant population numbers (over 15) to determine prevalence values. However, these values are now for those on hormone therapy:

P(HTmf) [Elklund88]: 1:45,000 (in '80); 1: 26,000 (in '83); 1:18,000 (in '86)
P(HTfm) [Elklund88]: 1:200,000 (in '80); 1:100,000 (in '83); 1:54,000 (in '86)

By counting people who had begun hormone therapy rather than those who had simply approached the clinic and sought help, this report started a trend towards incommensurability of reported results from one study to another [Conway07]. However, this report does indicate awareness that the results are lower bounds on the prevalence of transsexualism.

Tsoi88:

This report also used Wålinder's criteria for identifying transsexual people. However, it based its calculation of the "prevalence of transsexualism" in Singapore on counts of SRS's obtained from the Department of Obstetrics and Gyneacology at the National University of Singapore, plus reports from two private surgeons.

Up to 1986, 343 mf and 115 fm trans people had come forward to Singapore medical authorities seeking and undergoing SRS. Note that the average age was 24.1. The 1986 Singapore population (> 15) was 979,300 males and 954,900 females, and so [Tsoi88] reported prevalence results, now of SRS, as follows:

P(SRSmf) [Tsoi88] = 1:2,900
P(SRSfm) [Tsoi88] = 1:8,300

[Tsoi88] discusses the difficulties of determining the prevalence of transsexualism using standard epidemiological methods (surveys, samplings). However, the report does not suggest that its results are simply lower bounds on the prevalence of transsexualism, perhaps because its results were much higher than those reported elsewhere.

Bakker93:

This report uses Wålinder's definition, and builds on [Eklund88] by bringing the AZVU clinic counts up to date. However, in this report *"The prevalence of transsexualism in The Netherlands was estimated by counting all the subjects who were diagnosed as transsexuals by psychiatrists or psychologists and who were subsequently hormonally treated and generally underwent sex-reassignment surgery"* [Bakker93]. In other words, these counts reflected the numbers on hormone therapy, but also noted that a substantial but unspecified fraction had also had SRS:

P(HTmf) [Bakker93] = 1:11,900
P(HTfm) [Bakker93] = 1:30,400

The report does not indicate that its prevalence values are lower bounds. Instead it began a trend towards visualizing reported numbers as absolute values, a trend furthered by reporting results to three significant digits (with no error margins indicated).

Taken together, the combination of [Eklund88] and [Bakker93] imply a rapid increase in the prevalence of sex reassignments over time. The 1980 mf prevalence was 1 in 45,000, in '83 it was 1 in 26,000, in '86 it was 1 in 18,000 and in '90 it was 1 in 11,900. The papers show an awareness of the increase, but give only speculative reasons why it might be occurring, and apparently missed the underlying cause.

During the period involved, the male population was rather stable in The Netherlands but the number of accumulated patients kept on increasing for an obvious reason: Most patients treated since 1976 were likely still alive (after a longer period, corrections would be necessary to account for those who had passed away). Thus what is being observed is simply a "start-up transient" in the incidence of sex reassignments in The Netherlands during the 1980's, in which the sum total of reassignments is rising from small numbers towards some as yet uncertain asymptotic value (see further discussion in Section 4 of the start-up transient revealed by these papers and by [VanKesteren96]).

[Bakker93] has been widely cited in recent years by WPATH (HBIGDA) [WPATH01], and by many others, as the definitive determination of the "prevalence of transsexualism".

However, as we can see, [Bakker93] did not measure the prevalence of the inherent condition of transsexualism under Wålinder's definition. Instead it measured the prevalence of gender reassignments (mostly involving SRS) in gender clinics in The Netherlands during the 1980's. Thus [Bakker93] merely determined a lower bound on the prevalence of SRS in The Netherlands at the time, while stating results as absolute ones [Conway07].

VanKesteren96:

This report builds on [Bakker93], first presenting the same summary results that had been compiled in that paper up to 1990, which in our notation are as follows:

P(HTmf) [VanKesteren96] = 1:11,900
P(HTfm) [VanKesteren96] = 1:30,400

However, unlike [Bakker93] this paper does not continue to calculate new prevalence numbers from the now available data up until 1992. If it had done that by dividing accumulated patients by 1992 by the total population, this would have led again to larger prevalence numbers.
Instead, it goes on to tabulate and analyze detailed demographic information regarding the participants. That information enables calculation, as in [Conway07], of the numbers only on hormone therapy and of those who had also undergone SRS, and thus calculation of the prevalence of SRS at those clinics:

P(SRSmf) derived by [Conway07] from [VanKesteren96] = 1:17,500
P(SRSfm) derived by [Conway07] from [VanKesteren96] = 1:41,000

By presenting the prevalence of gender reassignments, carrying out the results to three significant figures, and not indicating that these were lower bounds, [VanKesteren96] furthered a trend in this literature towards (i) measuring the prevalence of SRS and then calling it the prevalence of transsexualism, and (ii) visualizing the reported values as precise measurements of the prevalence of inherent condition of transsexualism. Thus [VanKesteren1996] cemented an implicit re-definition of transsexualism (for the purposes of prevalence calculations) as meaning "someone who has undergone gender reassignment" [Conway07].

Weitze96:

[Weitze96] reviews the effect of the Transsexuals' Act (TSG) in Germany from 1981-1990 (its first ten years), and discusses the differences in the social/bureaucratic treatment of transsexual people by the various European countries. The study submitted questionnaires to all relevant German courts regarding first name changes and legal reassignment of sex, and determined that during those years the number of legal status changes trended towards 100 per year, with roughly 70% being mf transitions. The study did not tabulate prevalence or incidence values, but simply the numbers of legal cases of various types per year. Even so, this is an important paper, for it was the first to identify the incommensurability of prior prevalence reports (a fact ignored by later reports, which continued to tabulate results as if they were commensurable):

"Table I provides an overview of the results obtained in studies conducted to date. Owing to fundamental differences among data collection methods, the possibility of comparing these studies is limited, and any conclusions drawn from them on the frequency of the phenomenon of transsexuality are subsequently problematic" [Weitze96].

DeCuypere06:

Jumping ahead to the current day, we find that reports on the prevalence of transsexualism tend to follow the trend established by [Bakker93] and [VanKesteren1996]. For example, in a representative current-day study, [DeCuypere06] conducted a survey of Belgian surgeons to obtain a count of individuals up to 2003 who had undergone SRS by Belgian surgeons since 1985, with the following results:

P(SRSmf) [DeCuypere06] = 1:12,900
P(SRSfm) [DeCuypere06] = 1:33,800

[DeCuypere06] refers to the prevalence of sex reassignment surgery as "the prevalence of transsexualism", and therefore follows the pattern set by [Bakker88] and [VanKesteren96] of implicitly defining a "transsexual person" as being "someone who has undergone SRS". The report does not indicate that these are lower bounds on the prevalence of SRS, and carries out the results to three significant figures.

Comments:

All of these past reports on the prevalence of transsexualism contain valuable data and tabulations of counts of treatments provided to transsexual people by the various gender clinics over time.

However, the results of these prevalence studies down through the years are incommensurate, as pointed out by [Weitze96], and thus they cannot be directly cross-compared in linear tabulations. In order to make meaningful comparisons of such results, they must first be normalized, by taking into account the differences in their implicit definitions of "transsexualism" and their differences in what is actually being “counted”. Furthermore, some reports present data that conflate incidence and prevalence information, and must be time-adjusted in order to gain commensurability.

[Note: See [Conway07] for a detailed cross-comparison of a more complete set of past studies, including methods for normalizing results to insure commensurability and tabulations of normalized results]

In order to make clear which type of prevalence is being discussed at any given point, we introduce the following symbols for the different types of prevalence. All except the first involve overt actions that are subject to possible counts as observables:

P(TS) = the prevalence of transsexualism, under Wålinder’s definition*,
P(SH) = the prevalence of transsexual people who have sought help from a caregiver,
P(HT) = the prevalence of those on hormone therapy,
P(ST) = the prevalence of those who have socially transitioned, and
P(SRS) = the prevalence of those who have undergone SRS.

[*If an alternative definition is used, it should be so-noted.]

In most countries, we generally find that P(TS) > P(SH) > P(HT) > P(ST) > P(SRS), with the various ratios being factors of many local conditions.

This a useful set of inequalities to keep in mind, for if we know one of these prevalence values, and can estimate some of the ratios amongst them (perhaps by epidemiological survey methods), we can then estimate some of the others prevalence values too.

[Note: In countries where social transition (i.e., Real Life Experience) precedes approval for hormone therapy, the P(HT) and P(ST) values may need to be reversed. In other countries such as Thailand, the sequence may need even further adjustment, as follows: P(TS) > P(ST)> P(HT) > P(SH) > P(SRS)].

For example, if a survey determines the ratio of those on hormones to those who have undergone SRS to be about 2 to 1 in some country, and if a prevalence count determines that P(SRSmf) = 1:5,000 there, we can infer that P(HTmf) is approximately 1:2,500 in that country. By using calculations of this form, we can sometimes work backwards from measures of the prevalence of SRS, to make projected estimates of the prevalence of transsexualism, as done in [Conway01], [Conway07] and [Kelly01].

3. Definitions and methods of calculation:

In this section we provide definitions and methods of calculations we will use in Section 4 to refine and extend the results of the above reports.

Prevalence: The Prevalence of a condition C is the number of individuals having the condition divided by the number of individuals in the relevant population at a given time. I.e., it is the fraction of the relevant population having the condition at some particular time, and is therefore a dimensionless quantity (i.e., a ratio):

P(C) = (number of people having condition C) / (number of people in the population).

Incidence: The Incidence of a condition C is the number of new cases of the condition that arise in a population during a specific period of time, usually one year.

Incidence may be expressed (i) as a number affected by the condition in a given year, (ii) as a fraction of the total population affected by the condition in a given year, or (iii) as a fraction of the number born with the condition in a given year (for birth conditions).

$I_n(C)$ = number of new cases of condition C per year = n cases of C per year.

$I_P(C)$ = [($I_n(C)$ new cases per year)] / (total population) = fraction of population getting condition C, per year.

$I_B(C)$ = ($I_n(C)$ new cases per year) / (number of births per year) = fraction of births having C.

Under these definitions, $I_n(C)$ and $I_P(C)$ have the dimensions of [1 / T], while $I_B(C)$ has the dimensions [1 / 1] and thus is dimensionless. Note that we must be very clear about which form of incidence being reported, because they are all quite different in nature and number. Also note that I_B(birth) = 1.

For more on the definitions of prevalence and incidence, see [Coggon03].

Constant vs non-constant population demographics and conditions:

Constant demographics is a theoretical model we use for purposes of exposition. A population having constant demographics is one in which the total population is unchanging, there is no immigration or emigration, the death rate equals the birth rate, and the mortality statistics are unchanging. This model simplifies our discussions of epidemiological phenomena, and enables us to develop useful algebraic relationships that quantify such phenomena in populations having only slowly changing demographics, including analyses of start-up transients in conditions within such populations.

We will often model conditions as having constant incidence rates from year to year, rather than changing incidence rates. Note that some naturally-occurring conditions (such as common diseases) often have roughly constant incidence, while other conditions (such as the flu and various medical treatments) may have quite variable incidence rates.

[Conway and Olyslager07] containing a more extensive presentation of the analytical methods initially presented in this report. We refer readers to that webpage for information on the analysis of non-constant demographic populations affected by time-varying birth rates, condition incidence rates, mortality rates, etc.

Visualizing results as lower bounds:

Many past reports discuss the difficulty in measuring the prevalence of transsexualism, noting that reported counts are almost always undercounts of the underlying phenomena.

The resulting estimation problems are thus analogous to estimations of outside air temperature from inside a home without using a thermometer. For example, we might awake after a cold night and notice that the water in a birdbath is no longer frozen. From this observation, we can estimate that the outside temperature has risen to greater than 0° C. However, we cannot tell how much higher it has risen. All we can say is that T > 0° C, and so we have only found a lower bound on T, which we can symbolize as $\underline{T}$ = 0° C.

It is important to keep this concept in mind as we discuss prevalence estimates, for in almost all cases the counts and reported results are only lower bounds – and contain no indication of how much larger the actual values might be. Thus the error margin on the "high side" of such estimates is not identified (i.e., is unbounded).

In such situations, later studies can make significant contributions if/when they uncover evidence of higher lower bounds than previously reported ones – or if they can identify some form of upper bound - thus narrowing the range of possible values of measurement of the underlying phenomena.

Relation between incidence and prevalence for short- and long-duration conditions:

The relationship between the prevalence of a condition in a population at some point in time and the annual incidence of onsets of the condition is a complex one, and depends strongly on the mean duration of the condition.

For example, if the average person in some population gets a common cold once every four years, then the annual incidence of colds is 25%, expressed as a fraction of the population (I_P(common cold) = 1:4 per year). Thus in a population of 100,000 people, about 25,000 would get colds each year (I_n(common cold) = 25,000 per year), which is a very large number indeed.

However, if the mean duration of those colds is 4 days (about 1/90th of a year), then only 1/90th of those 25,000 people per 100,000 who get colds each year would have a cold at the same time. Thus only about 280 per 100,000 would have colds at the same time in that population, and thus the prevalence of colds, P(common cold) ≈ 1:360.

As we see, the prevalence of very short-duration conditions is numerically much smaller in value than the annual incidence rates might suggest. However, we will find that the situation is reversed in long-duration conditions, with prevalence being much larger than incidence rates might suggest, as in the following example:

There are many conditions that are evident at birth, and even if later corrected the fact of their occurrence is lifelong. For example, the annual numerical incidence of orofacial clefts in the US is about I_n = 7,500 births out of the approx. 4,000,000 births occurring in the overall population of 300,000,000 people [WebMD06].

Thus the annual incidence of orofacial clefts when quoted as a fraction of the overall population is I_P(orofacial cleft) = 1:40,000, per year, which at first glance seems like a very small number.

However, when the annual incidence of orofacial clefts is quoted as a fraction of annual births, it appears to be far higher, because this form of incidence I_B(orofacial cleft) = I(orofacial cleft)/I(birth) = 1:530.

In other words, the fact that orofacial clefts appear in about 1 in 530 of the 4,000,000 births in the US each year is a much better indicator of the occurrence of orofacial clefts than is the annual incidence when quoted as 1:40,000 out of the total population per year (In the next section we demonstrate that the indicator I_B is under certain conditions numerically equal to the prevalence.).

[Note: We often find population incidence, I_P, being reported in studies of transsexualism, with a similar effect on making a not uncommon condition appear to be extremely rare.]

Thus for long term conditions it is more meaningful to report annual incidence as a fraction of annual births. And in any event, we must be very cautious when reporting incidence for long-term conditions - making it very clear whether the values are ratios of total population, or of annual births.

Calculating prevalence of lifelong conditions from incidence rates and birth rates:

In this section, we first show that, in constant-demographics populations with birth incidence = I(birth), the prevalence P(C) of any constant incidence condition, C, of lifelong duration is given by the following (assuming that condition C does not affect life expectancies):

Equation 1: P(C) = I(C) / I(birth)

[Note: These incidence values must be in commensurate form, i.e., they must both be in either numerical form, I_n, or in equivalent ratioed form I_B or I_P, where I_B(birth) =1.

In other words, the long-term convergent value of the prevalence of birth condition C is equal to the annual incidence I(C) of onsets of condition C, divided by the annual incidence of births of persons capable of developing condition C.

This is easy to demonstrate: Consider a population having an age-profile "pyramid" as in [StatsGovUK], which shows the numbers of people alive, N_i, for each annual age, i, from 1 to 100 (beyond which the numbers are vanishingly small). The total number in the population is then given by:

$$N_{Tot} = \sum (N_i), \text{ for } i = 1,100$$

Of the N_i remaining alive at each age i, the number remaining at that age having condition C is equal to N_i times the fraction of those at that age who were born with condition C. I.e., $N_i(C) = N_i$ (I(C)/I(birth)).

Thus the total number $N(C)_{Tot}$ in population N_{Tot} having condition C is given by:

$$N(C)_{Tot} = \sum [(N_i)(I(C)/I(birth))] = I(C)/I(birth) \sum (N_i), \text{ for } i = 1,100 = I(C)/I(birth)\ N_{Tot}$$

Therefore: $N(C)_{Tot} / N_{Tot}$ = P(C) = I(C) / I(birth)

This relationship is easy to visualize, for example, in the case of orofacial clefts: Since the annual incidence of these conditions as a fraction of all births is 1 in 530 and the conditions are of lifelong duration (as having occurred), and assuming that this condition does <u>not</u> affect life expectancies, the remaining fraction of all people who have or have experienced the condition will tend towards 1 in 530.

Thus for orofacial clefts in the U.S., P(orofacial cleft) = I(orofacial cleft) / I(birth) = 7,500/4,000,000 = 1/530, and we see that the prevalence of the condition is numerically equal to the annual incidence when expressed as a fraction of the annual number of births.

Calculating latent, active and inherent prevalences of later-onset lifelong conditions from incidence rates and birth rates:

Now, suppose that a constant-incidence condition C is inherent but latent at birth, and only becomes active at an average age, T_A (the average age of onset), and then continues for the remainder of a person's life. In this case, we define three sub-populations having different forms of the "conditions": (i) a latent form, (ii) an active form, and (iii) the inherent form (i.e., those having either the latent or active conditions):

C_I = being born with the inherent condition.
C_L = being born with the condition, but not yet experiencing active onset.
C_A = having experienced active onset of the condition.

From these definitions we have (for a condition with constant birth incidence $I_B(C)$):

Equation 2: $P(C_I) = P(C_L) + P(C_A)$

For conditions in which most people experience active onset during the early years of their lifetime (i.e., which do not long remain latent), we can see that to a first approximation the annual incidence of active cases is equal to the annual incidence of births having the inherent condition. In other words, in a steady state population, the sum of the numbers of people at various ages of onset who transition to active cases each year will be roughly equal to the number of people born each year with the inherent condition.

However, some people with the condition will pass away each year (even when young). Therefore, some latent cases never become active – and so $I(C_A)$ will be somewhat smaller than $I(C_I)$ would indicate. These effects, whether large or small, can be estimated for some conditions from population "pyramid" data, and data on the age-distribution of onsets of active cases. In any event, we have:

Equation 3: $I(C_A) \leq I(C_I)$

Or alternatively for some value $k_A \leq 1$, we have:

Equation 3a: $I(C_A) = k_A\, I(C_I)$, where k_A = the fraction of cases that survive to become active.

Equation 1 can now be applied (for a steady-state population and steady-state condition C_I, as follows:

Equation 4: $P(C_I) = I(C_I) / I(B) \geq I(C_A) / I(B)$

In other words, a lower bound on the prevalence of the inherent form of the condition can be inferred from the ratio of the overall annual incidence of active onsets of the condition to the annual incidence of births in the population. Note again that since some latent cases will pass away before becoming active, $P(C_I)$ will be greater than the ratio $I(C_A) / I(B)$ would indicate, and thus estimating $P(C_I)$ as being $\approx I(C_A) / I(B)$ yields a conservative (i.e., low) estimate of $P(C_I)$.

We can now infer the prevalence of the inherent form of a condition from the active form, or vice-versa, by calculations based on the average age of onset. Clearly, the prevalence of active cases is less than the prevalence of inherent cases, because it is reduced by the ratio of the average numbers of years of life after onset to the total number of years of expected life. Thus in conditions where all inherent cases transition to active cases at some point in life, with the onsets occurring at an average age T_A, we have:

Equation 5a: $P(C_A) = [(T_E - T_A)/T_E]\, P(C_I)$, and
Equation 5b: $P(C_I) = P(C_A)\, [T_E /(T_E - T_A)]$, where:

T_A = the average age of onset of the condition
T_E = the average life-expectancy in the population
$(T_E - T_A)$ = average years of life after onset

However, for conditions where not all inherent cases transition to active cases at some point in life, the prevalence of the active condition is reduced by the ratio of incidences of latent cases to active cases at the time of death – which we may be able to estimate for some conditions. For example, suppose that on average only the fraction k_A of the inherent cases ever become active cases before passing away. We would then have:

Equation 5c: $P(C_A) = k_A\, [(T_E - T_A)/T_E]\, P(C_I) \leq [(T_E - T_A)/T_E]\, P(C_I)$, and
Equation 5d: $P(C_I) = (1/ k_A)\, P(C_A) /((T_E - T_A)/T_E) \geq P(C_A)\, (T_E /(T_E - T_A))$

Extending estimates of SRS prevalence to latent and inherent SRS prevalences:

Suppose that we have determined a lower bound on the prevalence of SRS in a constant-demographics population. We can then apply Equation 4 to making estimates of lower bounds of the latent form of the condition (i.e., the statistical numbers of people in the population that have not yet undergone SRS but will at some later point in life) and the inherent form of the condition (the total number of people in the population who have undergone SRS plus the statistical number who will undergo SRS).

In the populations studied in many of the earlier reports, we find that the mean age of onset of SRS is around 35 (see for example the range of numbers in [VanKesteren96], [Olsson03] and [DeCuypere06]), while life expectancy is around 75. In such populations, a good working number for the ratio of active versus inherent forms of the condition is given by:

Equation 6: $P(SRS_A) = [(75 - 35)/75]\, P(SRS_I) = 0.53\, P(SRS_I) \approx ½\, P(SRS_I)$

[Note that we use age-ranges starting from birth (instead of age 15) when projecting back from active case numbers to estimate inherent case numbers, with results correct to the first order if few cases become active before age 15.]

Thus if we determine an estimate of the prevalence of SRS in a constant-demographics population (the prevalence of “active” cases who have undergone SRS), we can then estimate the statistical prevalence of both the latent and the inherent forms of the condition of “someone who will undergo SRS” in that population:

Equation 7: $P(SRS_L) \approx P(SRS_A)$
Equation 8: $P(SRS_I) = P(SRS_L) + P(SRS_A) \approx P(SRS_A) + P(SRS_A) = 2\, P(SRS_A)$

This is a very important result to grasp and visualize: In current-day populations having near constant-demographics, the statistical prevalence of the inherent condition leading to SRS is approximately twice the prevalence of those who have already undergone SRS, because the average transitioner only lives approximately half of their life post-SRS.

If in future years, average ages of transition trended lower (to say around 25) and life-expectancies became longer (to say around 80), then transitioners would live 2/3 of their lives post-transition (as is the case even now in countries such as Thailand). In such cases we find:

$P(SRS_A) = ((80 – 25)/80)\ P(SRS_I) = 0.66\ P(SRS_I) \approx 2/3\ P(SRS_I)$
$P(SRS_L) \approx ½\ P(SRS_A)$
$P(SRS_I) = P(SRS_L) + P(SRS_A) \approx ½\ P(SRS_A) + P(SRS_A) = 1.5\ P(SRS_A)$

Extending estimates of inherent SRS to those of inherent transsexualism:

As Wålinder recognized years ago [Wålinder68], it is the prevalence of the inherent condition of transsexualism that we seek (and that is so difficult to measure) – and that the public wants to know. The public wants an answer to the question: "What is the chance for a boy or a girl to be transsexual?"

Therefore, it is very important to differentiate between the prevalence of "treatments" of transsexualism (i.e., the prevalence of such things as hormone therapy or SRS) and prevalence of the inherent underlying condition itself.

There is a very complex relationship between the modern innovations in gender modification technology (such as hormone therapy and SRS), and the emergence of increasing numbers of transsexual people who openly undertake gender transitions.

Of course, even before the availability of hormone therapy and SRS, there were in many societies (and still are) some percentage of transsexual people who decided to, and were able to, undertake some form of social transition.

As hormone therapy and SRS became available, increasing percentages of transsexual people could visualize the possibility of successful transitions, and the prevalence of those seeking treatment gradually increased in those and other countries.

Thus began a complex co-evolution of (i) modern gender modification technology and (ii) the individual and social customs for gender transitions of various kinds in various societies.

As we have seen in Section 2, it has been much easier for researchers to count those seeking help and getting treatments at gender clinics, rather than to attempt epidemiological sampling of overall populations for the inherent condition. Thus the trend in recent years has been to count SRS's (especially at government-sponsored gender clinics) and then report the resulting prevalence numbers as the "prevalence of transsexualism".

However, this clearly results in massive underreporting of the prevalence of the inherent condition. Such counts do not take into account the large number of latent cases who cannot afford, or choose not to, make contact with any clinic. Or those for whom a clinic is just not available. Or those for whom the technology is not yet adequate to enable them to visualize successful transitions.* Or those so fearful and frightened of social ostracism that they dare not seek help, or those who in fact have obtained treatment in stealthy ways and slipped under society's radar, or those that due to insufficient knowledge never come to self-awareness of the underlying nature of their situations.

[*For example, the innovation of modern facial feminization surgery (FFS) is enabling an additional fraction of those experiencing mf transsexualism to visualize, and in some cases undertake, successful gender transitions.]

Therefore, even a projection of $P(SRS_I)$ as equal to $2P(SRS_A)$, as in Equation 8, does not yet hint at what the overall prevalence of the inherent condition might be in any given society, other than to provide a very conservative lower bound on the condition.

So, how can we begin to better measure the inherent prevalence of transsexualism?

First we note that the following inequality relationships exist in many societies (noting that in a few countries social transition (i.e., RLE) precedes approval for hormone therapy, and in such cases HT and ST may need to be reversed in the inequality sequence):

Equation 9: $P(TS) > P(SH) > P(HT) > P(ST) > P(SRS)$.

If we can measure some of the active and inherent prevalences (SRS, ST, HT, SH), and also conduct sampling and surveys to estimate the various ratios amongst them, we may then use Equation 9 (and the other equations above) to extrapolate from these measures and ratios to derive likely lower bounds on the prevalence of transsexualism.

Estimations of Prevalence and Incidence in non-constant demographics populations:

In ongoing support of this report and the methods initially presented here, we have developed a webpage [Conway and Olyslager07] that contains a more extensive presentation of the definitions, notation, equations and methodology used here. Included are analyses of these phenomena in non-constant demographic populations affected by time-varying birth rates, condition incidence rates, mortality rates, etc.

Note, however, that in many cases we can make good second-order adjustments for such effects without resorting to a more general analysis. E.g. in the Netherlands the birth rate has changed considerably during the past 50 years. However, this effect can be compensated for by simply replacing the current birth rate I(B) in Equation 4 by the birth rate N years ago, where N is the average SRS or HT age under study.

4. Applications of these methods to refine and extend the results of oft-cited papers:

Let us now look more closely at papers discussed above, and look more closely at what they “really counted”, i.e., whether they counted people seeking help, or those on hormones, or those who had had SRS, etc. We can then apply our definitions of the various types of prevalences, along with the key equations above, to refine and extend the results of those papers (doing so using those papers’ own data).

[Wålinder68]:

This paper provided a definition of the inherent condition of transsexualism, and went on to provide a lower bound on the inherent condition by counting those seeking help in Swedish clinics through 1965 (i.e., during the first early years of the modern surgical treatment of transsexualism). From those counts [Wålinder68] determined that:

$P(SH_A mf)$ [Wålinder68] = 1:37,000
$P(SH_A fm)$ [Wålinder68] = 1:103,000

[Wålinder68] does not provide data on the average age of those seeking help. However, even if we assume a conservative (i.e. young) value of 25 years for the mean age of seeking help and a life expectancy of roughly 75, we find from Equation 5b that the inherent prevalence of those who had or would seek help is at least the following:

$P(SH_I mf)$ *derived from* [Wålinder68] ≈ 1:37,000 [75/(75-25)] = 1:25,000
$P(SH_I fm)$ *derived from* [Wålinder68] ≈ 1:103,000 [75/(75-25)] = 1:69,000

[Hoenig74]:

From data in [Hoenig74] and demographic data found on [http://www.statistics.gov.uk] we can find an estimate for $P(SH_I mf)$ in 1968 for the Manchester region in the UK.

[Hoenig74] Fig. 1 shows a sudden onset of non-negligible numbers of cases in 1962, with an average of 9 annual cases of mf and fm patients each year from 1962 through 1968. These are counts of those who went to seek help (and that satisfy the Wålinder criteria). Using an mf/fm ratio of 2.88/1 as mentioned in [Hoenig74] this means on average 6.68 annual mf cases each year. The average age of those seeking help was about 25 years.

From [http://www.statistics.gov.uk] we find in 1970 a total population of 15 years and over in England and Wales of 36,900,000 of which 329,400 males were 25 years of age in 1968. Ignoring second-order mortality effects in our first-order calculation, let us assume that there were 329,400 male births in 1943 (25 years before 1968). From [Hoenig74] we know that the total population of 15 years and over in the Manchester region was 3,498,700. Using a proportionality rule this leads to 31,200 male births in 1943 in the Manchester region. By using Equation 4 we thus find:

$P(SH_I mf)$ *derived from* [Hoenig74] $\geq I_n(SH_A mf) / I_n(Bm) = 6.68/31{,}200 \approx$ 1 in 4,700

And by a similar calculation, we find that:

$P(SH_I fm)$ *derived from* [Hoenig74] $\geq I_n(SH_A fm) / I_n(Bf) = 2.32/30{,}700 \approx$ 1 in 13,200

Note also that by the late 60's, many mf transitioners in the UK opted to go abroad for SRS, with many going to Burou in Casablanca [Morris74], the pioneer of the modern mf SRS surgical technique. Thus many UK mf transitioners went uncounted in such reports.

[Tsoi88]:

The calculation of the "prevalence of transsexualism" in Singapore in [Tsoi88] was based on actual counts of SRS. Thus the reported prevalence was of the form and value:

$P(SRS_A mf)$ [Tsoi88] = 1:2,900

In this case, the surgeries had been performed for a number of years. [Tsoi88] reports them occurring at an average age of 24.1 (in a population having a life expectancy of ~ 75). By using Equation 5b, we can infer a likely lower bound on $P(SRS_I mf)$, i.e., the prevalence of those who have had mf SRS and those tracking towards SRS, as follows :

$P(SRS_I mf)$ *derived from* [Tsoi88] ≈ 1:2,900 [75 / (75 – 24.1)] = 1:2,000

Similarly, since $P(SRS_A fm)$ [Tsoi88] = 1:8,300, we find that:

$P(SRS_I fm)$ *derived from* [Tsoi88] ≈ 1:8,300 [75 / (75 – 24.1)] = 1:5,600

[Eklund88], [Bakker93] and [VanKesteren96]:

From data available in [Eklund88], [Bakker93] and [VanKesteren96], we find that 507 patients were classified as having undergone "reassignment" (up through at least HT, with most already having had SRS) during the period from 1976 to 1990. This number excludes those patients born outside the Netherlands. The number of patients reassigned during the interval 1976 -1986 is 399. However, this number includes patients born outside the Netherlands. Using a proportionality rule, based on numbers in [Bakker1993], we estimate that 28 patients out of these 399 were not born in the Netherlands. Thus 371 of those patients were born inside the Netherlands.

Hence, in the 4 year interval from 1986 to 1990, 507-371 = 136 mf patients from the Netherlands began treatments at these clinics (hormone therapy leading later in most cases to SRS), for an annual incidence of active cases $I_n(HT_A mf)$ = 136/4 = 34.

The incidence of male births in The Netherlands in 1990, $I_n(Bm)$ = 101,700 [BBVS07]. However, there had been a decline in birth-rates there during the 32 years since 1958 when those of average-age of onset of active HT in 1990 had been born. In 1958, the incidence of male births was 120,000 [BBVS07].

Therefore, by using Equation 4, the projected prevalence of inherent cases of eventually active hormone therapy can be calculated as:

$P(HT_I mf)$ *derived from* [Bakker93] ≥ 34 / 120,000 ≈ 1:3,500

This result can then be used to infer the prevalence of the condition of active hormone therapy, $HT_A mf$, by using Equation 5b above, as follows:

$P(HT_A mf)$ *derived from* [Bakker93] = [(75-32)/75] $P(HT_I mf)$ ≥ 0.57 (34 / 120,000) ≈ 1:6,200

In other words, if the 1986 to 1990 incidence of "reassignments" (through at least HT) had existed for a long time in the past and continued at that same rate well into the future (and if the population demographics of the Netherlands were to remain roughly constant), then the prevalence of active cases of mf "reassignment" would converge over time to at least 1 in 6,200, and the inherent prevalence of such mf reassignments would converge to at least 1 in 3,500.

We also find from 1986 to 1990 there were 203-129 = 74 fm patients, hence $I_n(HT_A fm)$=18.5 per year. The mean age was 23 years and in 1990-23 = 1967 there were 115,000 female births. Thus:

$P(HT_I fm)$ *derived from* [Bakker93] ≥ 18.5 / 115,000 ≈ 1:6,200
$P(HT_A fm)$ *derived from* [Bakker93] = [(75-23)/75] $P(HT_I fm)$ ≥ 0.69 (18.5 / 115,000) ≈ 1:8,900

The above values do not suffer the effects of the relatively recent start-up transient in gender reassignments in the Netherlands. Therefore, based on the actual data in [Elklund88] and [Bakker93], we find lower bounds on inherent $P(HT_I mf)$ ≈ 1:3,500 and $P(HT_I mf)$ ≈ 1:6,200.

Furthermore, given that P(TS) > P(SH) > P(HT), the lower bound on the inherent prevalence of transsexualism must be some moderate multiple of those P(HT) values, and thus many times the "prevalence of transsexualism" of 1:11,900 and 1:30,400 reported in [Bakker93] itself – i.e., many times greater than the prevalence numbers oft-cited by WPATH to this day.

[Olsson03]:

From [Olsson03] we infer that over a period of 16 years, from 1986 until 2002, 114 male patients received SRS in Sweden, for an average of 7.1 patients per year. From [Olsson03] we also infer that only 76% of these are of Swedish origin, leading to 5.2 Swedish origin mf SRS patients each year. The average age for requesting SRS was 36.5. It is not clear how much time there is between the request and the actual surgery but let us assume an average SRS age of 38 years. There were 62,050 male births in 1964 (38 years before 2002) [http://www.scb.se]. Using Equation 4 we thus find that:

$P(SRS_I mf)$ *derived from* [Olsson03] $\geq$ 5.2/62,050 $\approx$ 1:12,000

There were on the average 5.6 fm patients per year of which 67% were of Swedish origin. The average age was 31 years and in 2002-31 = 1971 there were 54,424 female births.

Thus $P(SRS_I fm)$ *derived from* [Olsson03] $\geq$ 3.75/54,424 $\approx$ 1:14,500

Even today in Sweden the eligibility criteria for SRS [Olsson2003] seems much more stringent than those discussed in the WPATH Standards of Care, Version 6 [WPATH01]. Perhaps a similar situation was partly the explanation for the relatively low prevalence there of both mf and fm SRS in past decades.

[DeCuypere06]:

In [DeCuypere06], we find that during the 18 years from 1985 until 2002 there were 292 mf patients who received SRS performed by plastic surgeons in Belgium that responded to a questionnaire. Thus there were on average 16.2 mf patients receiving SRS per year. The annual number in 2002 was most probably larger, since the 18 year period contained the start-up phase in gender reassignment in Belgium (from [DeCuypere01] it can be inferred that the number of patients steadily increased during start-up).

The number of males born in Belgium during 1966 (i.e. 36 years before 2002) was 77,234 [http://statbel.fgov.be]. The average age of the SRS's was ~ 36 years [DeCuypere06].

Again, by using Equation 4, we find an inherent prevalence of SRS equal to:

$P(SRS_I mf)$ *derived from* [DeCuypere06] $\geq$ 16.2/77,230 $\approx$ 1:4,800

SRS counts are also given in [DeCuypere06] for the three distinct regions of Belgium. In a similar way as above, we find P(SRSmf) for each region:

$P(SRS_I mf)$ *derived from* [DeCuypere06] $\geq$ 12.7/45,575 $\approx$ 1:3,600 for Flanders
$P(SRS_I mf)$ *derived from* [DeCuypere06] $\geq$ 1.6/7,675 $\approx$ 1:4,800 for Brussels
$P(SRS_I mf)$ *derived from* [DeCuypere06] $\geq$ 1.9/23,984 $\approx$ 1:12,600 for Wallonia

Similarly, since the average age of fmSRS was 28, and thus taking female births in '74 into account, we find:

P(SRS_Ifm) *derived from* [DeCuypere06] ≥ 6.67/59,998≈ 1:9,000 for Belgium
P(SRS_Ifm) *derived from* [DeCuypere06] ≥ 5.06/33,959 ≈ 1:6,700 for Flanders
P(SRS_Ifm) *derived from* [DeCuypere06] ≥ 1.00/6,060 ≈ 1:6,100 for Brussels
P(SRS_Ifm) *derived from* [DeCuypere06] ≥ 1.16/19,979 ≈ 1:17,200 for Wallonia

[DeCuypere06] provides reasons why one would expect an agreement between the SRS prevalence numbers of Flanders and the Netherlands. And in the above we do notice a similarity in P(SRSImf) = 1:3,600 in Flanders (which we derived here from [DeCuypere06]), and P(HTImf) = 1:3,500 in the Netherlands (which we previously derived from [Bakker93]).

However, those two findings are incommensurate (one being P(SRSImf) and the other being P(HTImf)). Furthermore, the number of mf SRS cases in Flanders in 2002 is an underestimate, as mentioned above. Thus we see that the similarity is simply a coincidence.

[DeCuypere06] goes on to find an agreement between the prevalence numbers of the whole of Belgium and the Netherlands. However, there is a similar problem with that finding, for incommensurate measurements are being compared within that paper. Thus we believe that the apparent agreement in [Bakker1993] and [DeCuypere06] in the computed prevalence in the Netherlands (1 in 11,900 and 1 in 30,400) and that in the whole of Belgium (1 in 12,900 and 1 in 33,800) is simply a coincidence.

A further note: In [DeCuypere06] the male/female sex ratio is 2.43:1, but here we find a sex ratio of 1.9:1. This difference is due to changing demographics: Indeed, the average SRS age for fm is lower than mf and the birth rate has decreased from 1966 to 1974. This change in birth rate was not taken into account in [DeCuypere06].

5. Triangulation techniques: Common-sense checks of prevalence estimations

As we have seen, most of the above reports on the prevalence of transsexualism were based on data on the numbers of people being treated at official government-subsidized gender clinics in a handful of European countries, and are primarily based on counts of the numbers undergoing sex reassignment in those clinics.

However, there are many other methods for estimating the prevalence of transsexualism and sex reassignment, including various types of samplings and surveys that provide common-sense "triangulations" and sanity-checks on the rough numbers involved. We discuss some of these methods in this section, including the study that Conway published in 2001, which first raised the alert that something was very wrong with oft-cited prevalence numbers [Conway01].

As we will see, in many cases these triangulations lead to estimates of prevalence many times those reported by the European clinics. Although some of these methods are only based on rough surveys or small samples – or use age bases different from the traditional "over 15" one, nevertheless rather simple probability calculations indicate that it is extremely unlikely that the prevalence of transsexualism is as low as reported in the past studies by the European clinics.

Fellows of the IEEE

The Institute for Electrical and Electronics Engineers (IEEE) (http://www.ieee.org) is an international organization of electrical and electronics engineers in academia and industry. The total membership of the organization is around 375,000 from 150 countries.

The highest grade of membership is "IEEE Fellow". There are currently about 5,500 Fellows of the IEEE (the vast majority being male). We know of at least 3 Fellows of the IEEE who have undergone mfSRS, resulting in an SRS prevalence of at least 1 in 1,800.

This value of $P(SRS_A mf)$ could be an effect of the small statistical sample, or perhaps some form of relation between social status and prevalence. However, if the prevailing prevalence in the larger population is 1 in 12,000, then the probability of finding 3 cases in a subset of 5,500 in that population is only 1.6%, and thus is very unlikely:

Probability of (3mf in 5,500) = $C^3_{5,500} / 12,000^3 = 0.016 = 1.6\%$

Employees at Ghent University

The number of employees at Ghent University (http://www.ugent.be) is around 6,000, at least two of whom have had mf SRS. Assuming an equal distribution of employees in gender, this would lead to a prevalence $P(SRS_A mf) \approx 1$ in 1,500. The high prevalence could again be part due to a relation between social status and prevalence. Note, however, that if the prevalence of mf SRS in Belgium is indeed only 1 in 12,000, then the chance to have 2 in 3,000 is only 3.1%:

Probability of (2 mf in 3,000) = $C^2_{3,000} / 12,000^2 = 0.031 = 3.1\%$

Government employees in Flanders

There are about 10,000 employees in the Flemish government. A recent news article [Eeckhout06] indicates that at least 5 among them have had SRS. The article does not mention whether the 5 include mf and fm cases, or only mf cases. Assuming that both types were counted, and using a ratio $P(SRS_A mf) / P(SRS_A fm) = 2.43$ from [DeCuypere06], we infer that at least 3 of the 5 counted were mf SRS. Assuming that approximately ½ of the employees were born male, we find a prevalence of $P(SRS_A mf) \approx 1$ in 1,700.

However, if the prevailing prevalence of $P(SRS_A mf)$ in the larger population is only 1 in 12,000, then the probability of finding 3 cases in a subset of 5,000 in that population is only 1.2% (again the influence of social status might be in play, or perhaps persons with gender dysphoria are more likely to work in the more protective environment of government employment):

Probability of (3 mf in 5,000) = $C^3_{5,000} / 12,000^3 = 0.012 = 1.2\%$

Counts of SRS based on surgeon surveys

Lynn Conway first raised the alert that something was very wrong with the old but often cited prevalence numbers back in 2001 [Conway01]. By using initial data from the 1960's and '70's obtained from Harry Benjamin, M.D., and then tabulating counts of surgeries performed by top surgeons after that time, Conway presented estimates of the number of mf sex reassignment surgeries performed on U.S. residents during the preceding four decades, and determined that the likely prevalence of $P(SRS_A mf)$ in the U.S. was at least 1:2,500 at the time.

From this result, [Conway01] hypothesized that the likely lower bound on the prevalence of inherent male-to-female (MtF) transsexualism in the U.S. was on the order of ~1:500 and might be even larger.

That hypothesis seems plausible, for by using Equation 5 we now find a *derived* $P(SRS_I mf)$ from [Conway01] ≈ 2 $P(SRS_A mf)$ = 1:1,250, and from Equation 9 we know that $P(TS_I mf)$ must be larger than $P(SRS_I mf)$.

Furthermore, as Conway said in 2001: "We can do a quick sanity check of these results by calculating postop prevalence in a totally different way. . . .We can do this by dividing the ongoing incidence of SRS each year by the incidence of male births in the U.S. each year."

Conway pointed out that almost everyone knowledgeable about the situation in the U.S. would admit that at least 1000 mf SRS surgeries were being performed on U.S. residents each year by US surgeons. After all, the top three surgeons alone were doing over 400 such surgeries each year. When combined with the numbers done offshore in Thailand and Europe, it was likely that mf SRS was and still is being done on between 1,500 and 2,000 U.S. residents each year.

Thus we find according to Equation 4 and using our current notation that:

$P(SRS_I mf)$ *derived from* [Conway01] $\geq I_n(SRS_A mf) / I_n(Bm)$ = 1,500/2,000,000 ≈ 1:1,300

The [Conway01] report was posted on the internet in January 2001, and its hypothesis that 1:500 is a likely lower bound on the inherent prevalence of mf transsexualism immediately challenged the widely cited value of 1:30,000, a value then deeply institutionalized in the U.S. psychiatric community. [Conway01] also challenged the 1:11,900 value reported in newer studies from the Netherlands.

Later that year, [Kelly01] applied the same methodology to the UK, and found from government tabulations of SRS's that the $P(SRS_A mf)$ in the UK was at least 1:3,750. Using Equation 5 we now find a *derived* $P(SRS_I mf)$ from [Kelly01] ≈ 2 $P(SRS_A mf)$ ≈ 1:1,900.

Thus [Kelly01] also posed a major challenge to the earlier studies.

Counts of socially transitioned passers-by in Thailand:

Sam Winter of the Faculty of Education, University of Hong Kong, Hong Kong, has described an interesting new method for triangulating on the prevalence of transsexualism in his paper entitled "Counting Kathoey" [Winter02].

[Winter02] estimated the prevalence of socially transitioned women, i.e., $P(ST_A mf)$, in Thailand by counting "kathoey" among women passers-by at a number of public locations. Counts were done by "kathoey" who were top-experts at "reading kathoey".

[Winter02] found that approximately 6 per 1,000 (i.e., 1:167) Thai women passers-by were mf social transitioners. I.e., $P(ST_A mf)$ ≈ 1:167.

If even only a modest fraction of those kathoey (such as 1/3rd or 1/4th) turned out to be transsexual under Wålinder's definition, these results indicate an active prevalence of transsexualism in Thailand on the order of 1:700 at the least (see next section, where the results of a later survey suggest an even higher prevalence).

Note that these counts were done in cities where the prevalence of kathoey may be higher than in the country as a whole. Even so, the counts provide very interesting first-order estimates of the prevalence of socially-transitioned women in Thailand, estimates far higher than those in earlier European studies. Dr. Winter comments:

“Increasingly, I think the numbers of ‘gender dysphoric’ people in Thailand are no higher than elsewhere. What is higher is the probability that a person will act on their sense of self, rather than trying to suppress, it, wishing it will go away.” [Winter07].

Survey results regarding the percentage of Thai kathoey who have undergone SRS:

In follow-on work in a more recent paper [Winter06], Winter conducted a survey of 195 Thai transgender females (mf), and then compiled a very detailed demographic profile of this sample, covering many aspects of their lives, relationships and transitions. Included in [Winter06], Table 2a, p.20, is a tabulation of the percentage of participants reporting various transition events (such as living in female clothes (ST), taking hormones (HT), undergoing SRS, etc.).

[Winter06] found that 27.7% of those surveyed had already had SRS. The average age at SRS was 24.1, at ST was 18.4, and at HT was 16.3, while female life expectancy T_E = 73 [WHO07b].

By combining the results of [Winter02] and [Winter06] and using Equation 5, [Conway07] estimates that the prevalence of active and inherent SRS in Thailand as follows:

$P(SRS_A mf)$ *derived from* [Winter02, Winter06] = (0.277) (1:167) ≈ 1:600
$P(SRS_I mf)$ *derived from* [Winter02, Winter06] = (1:600) / [(73-24.1)/73] ≈ 1:400

Winter also determined that 48.2% of those who had not had SRS would like to have SRS. Therefore, 62.5% of the overall sample were transsexual under Wålinder’s definition:

I.e., the % having had or desiring SRS = 0.277 + 0.482(1.00 – 0.277) = 0.625 = 62.5%

By combining the results of [Winter02] and [Winter06], and taking 18.4 as an average age of ST (taking that as “active transsexualism” in the instances of transsexualism), [Conway07] then estimates the prevalence of active and inherent transsexualism in Thailand as follows (noting that these are first-order estimates, and may be influenced by a higher prevalence of kathoey in Thai cities than in the overall country):

$P(TS_A mf)$ *derived from* [Winter02, Winter06] = (0.625)(1:167) ≈ 1:270
$P(TS_I mf)$ *derived from* [Winter02, Winter06] = (1:270)/((73-18.4)/73) ≈ 1:200

Discussion of the triangulations

Some of the above indicators are based on small samples (the combinatorial indicators), and are thus only rough triangulations that are subject to large errors. Nevertheless, the ensemble of those indicators suggests that a prevalence of mfSRS on the order of 1 in 3,000 is far more likely in many of the countries involved than is a prevalence of 1 in 12,000. The other triangulations in [Conway01], [Winter02] and [Winter06] suggest the likelihood of even higher prevalence of mf SRS in Thailand and the U.S.

Given the many alternative ways of doing such triangulations, we encourage and challenge readers to innovate their own methods of collecting counts and sampling ratios that can then be used for estimating the active and inherent prevalences P(TS), P(SH), P(HT), P(ST),P(SRS) in various countries and subpopulations.

For example, we believe that special opportunities are rapidly opening up in the U.S. to poll the human resources departments in many large corporations now allowing transgender people to transition on the job here. In 2006, the Human Rights Campaign (HRC) listed 457 U.S. employers, including 122 Fortune 500 companies, that protect trans employees [HRC06]. Many of these companies are compiling data regarding gender transitions and trans medical treatments among their employees. Thus it may now be possible to gather useful new data on trans prevalence in many of these corporations.

6. Summary and Conclusions:

As we have seen, reports on the prevalence of transsexualism have gradually shifted over the years, from measuring the numbers of people seeking help to measuring the numbers undergoing SRS, thus increasingly straying away from measures of the prevalence of transsexualism.

Along the way such reports also ceased calling their results "minimal" (i.e., lower bounds), and began reporting results to two or three significant figures, suggesting that the results were widely applicable absolute values having small error margins.

Many reports were also affected by start-up transients in the annual numbers of SRS's performed during the years data was being collected. Thus many reports conflate measurements of prevalence and incidence.

As a result, the various reports down through the years are incommensurate and cannot be cross-compared via simple numerical tabulations of results, as presaged by [Weitze96]. Instead results must first be normalized to account for variations in the definition of transsexualism, in what is actually being counted, and in the time periods over which the counts occurred [Conway07].

In this paper we have presented mathematical methods that take all these issues into account, enabling us to mine and exploit the data from past reports in new ways, and to make useful new projections from data in those past reports - including projections aimed at answering the key question "What are the chances that my child is transsexual?"

First we developed methods for (i) projecting a more realistic value for the prevalence of SRS in a steady-state population from data during the SRS start-up transient (once the transient has leveled-off), and (ii) for projecting the inherent prevalence of the condition leading to SRS by taking into account the average durations of life pre- and post-SRS.

On applying these methods, for example, to data in [Bakker93] and [VanKesteren96], we found that their data imply an active prevalence of hormone therapy of $P(HT_A mf) \approx 1{:}6{,}200$ and $P(HT_A fm) \approx 1{:}8{,}900$ leading to lower bounds on inherent $P(HT_I mf) \approx 1{:}3{,}500$ and $P(HT_I mf) \approx 1{:}6{,}200$. These results are considerably larger than the reported "raw" prevalence figures of 1:11,900 and 1:30,400 given in [Bakker93] and [VanKesteren96].

[This is an important observation, because the figures of 1:11,900 and 1:30,400 are values still reported by WPATH as being "the prevalence of transsexualism".]

We then observe that by referring to such results as "the prevalence of transsexualism", those reports have further misled readers, who did not realize the reports were not answering the key question the readers had in mind, namely "What are the chances that my child is transsexual?"

Given the methods used in data collection and interpretation, those past reports have given the erroneous impression that the inherent transsexual condition is far rarer than it actually is. However, we can now determine much more realistic lower bounds on the prevalence of the inherent condition of transsexualism (under Wålinder's definition), by building upon improved analyses of the prevalence of HT and SRS – and then extending those results to estimate the prevalence of the underlying condition.

Our analyses of the data in key earlier reports lead to values of $P(SRS_I mf)$ in the range of 1:2,000 to 1:4,500 and $P(SRS_I fm)$ in the range of 1:5,500 to 1:8,000 in a number of countries, even way back during the 1980's.

Recalling Eqn. 9: $P(TS) > P(SH) > P(HT) > P(ST) > P(SRS)$, we know that the inherent prevalence of transsexualism must be a moderate multiple of the inherent prevalence of SRS, because only a fraction of transsexual people come out to themselves and others, seek treatments to resolve their conditions, and migrate fully from the inherent TS condition to undergoing SRS.

Therefore, even when using data from early reports, these factors already suggest a lower bound on the prevalence of inherent mf transsexualism on the order of 1:1,000 to 1:2,000.

Furthermore, more recent reports from Thailand, the UK, and the U.S. suggest an even higher lower bound on the prevalence of mf transsexualism, on the order of 1:500 (i.e., 0.2%) or more [Conway01], [Kelly01], [Winter02], [Winter06], [Conway07].

The number of people falling under the larger transgender 'umbrella' is by most accounts and definitions at least an order of magnitude greater than the prevalence of mf transsexualism. Thus the prevalence of mf transgenderism appears likely to be on the order of at least 1:100 (i.e., 1%) or more – and we see TG prevalence becoming an important topic for future studies.

The bottom line: The inherent prevalence of the transsexual condition, both $P(TS_I mf)$ and $P(TS_I fm)$, now appears to be nearly two orders of magnitude greater than the old figures of 1:30,000 and 1:100,000 so widely cited in the media. It is also appears to be more than one order of magnitude greater than the 1:11,900 and 1:30,400 figures currently cited by WPATH.

These findings have major implications for WPATH and the medical community, since many of the challenges and problems involved in providing for the health and well-being of transgender and transsexual people are directly proportional to their inherent numbers.

The findings also have major implications for the larger social and civil society – while in principle the problems of transphobia, prejudice and discrimination are as great an evil regardless of how many transpeople there are, in practice the blight they represent becomes larger the more people are suffering.

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On the Calculation of the Prevalence of Transsexualism*

By Femke Olyslager and Lynn Conway
September 6, 2007

*Paper presented at the WPATH 20th International Symposium, Chicago, Illinois, September 5-8, 2007.
http://ai.eecs.umich.edu/people/conway/TS/Prevalence/Reports/Prevalence%20of%20Transsexualism.pdf

Note to readers: We have submitted this paper for publication in the International Journal of Transgenderism (IJT). In addition to formal peer reviews conducted by the IJT, we would appreciate others' help in critical evaluations – in order to thoroughly refine the paper prior to its publication.

For more information, see the "Notes to Reviewers" at the following page, which includes our contact information, links to tutorials on the mathematics used in our paper, and links to related work in progress:
http://ai.eecs.umich.edu/people/conway/TS/Prevalence/Reports/Notes%20to%20Reviewers.html