

**ESTIMATING PARITY SPECIFIC RATE OF INDUCED
ABORTION: A NEW APPROACH**

Rajib Acharya

Contact:

Rajib Acharya

Resident Advisor, Macro International Inc.

c/o International Institute for Population Sciences

G.S. Road, Deonar

Mumbai – 400088,

Maharashtra, India

Phone: +91-22-5564883 (Off.)

+91-22-7549627 (Res.)

Fax: +91-22-5563257

E-mail: jippuiips@yahoo.com

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Introduction

Induced abortion is defined as deliberate wastage of fetus before 28 weeks of gestation and is being used for long period as an effective method of getting rid of unwanted pregnancy. If not performed in time and by professional medical person, induced abortion poses greatest threat to the reproductive health of a woman. Bongaarts *et al.* (1983), in their proximate determinant of fertility framework have identified induced abortion among the four most important proximate determinants of fertility.

Some studies have attempted to estimate the incidence of induced abortion, but, they often suffer from significant shortcomings. The difficulties they have encountered are (1) incomplete reporting of induced abortion (2) inability of distinguishing induced abortion and early spontaneous abortions by the respondents (3) unrepresentative nature of the study population and (4) error in methodology. Retrospective surveys collect data on abortion only on a life time basis. Accurate measurement of induced abortion is necessary for understanding the fertility dynamics of a population and for making projections about the future fertility.

In this study an attempt has been made to develop a methodology which may provide parity specific rate of induced abortion in a population. The method uses a parity progression model which relates observed period specific parity progression ratio with current parity specific contraceptive use in the population, parity specific rate of induced abortion and a single parameter, namely, 'period parity progression ratio in the absence of induced abortion'. The use of the model is demonstrated for India and its three selected states.

As discussed briefly earlier, the estimation of induced abortion faces manifold difficulties. The issue, which has attracted more address is the problem of under-reporting of induced abortion even in a population where laws regarding induced abortion are quite flexible. Several studies have been made to refine the survey methodologies to elicit the information on pregnancy loss.

Casterline (1989) has observed that though DHS calendars might well improve the coverage of pregnancy terminations beyond the estimated 50 to 80 per cent level achieved in World Fertility Surveys (WFS), a major obstacle to using these data to estimate induced abortion rates would remain: induced abortion are not distinguished from spontaneous terminations in the calendars. This distinction was first asked in Turkey DHS (TDHS), 1993.

Prior researches suggest that survey respondents are generally reluctant to admit

having had an induced abortion, particularly where the procedure is illegal, and thus they either fail to disclose such terminations or report them as spontaneous terminations (Barreto *et al.*, 1992; Casterline, 1989; Jones *et al.*, 1992). Besides household survey data, one most commonly used source for measuring abortion rates is hospital admission records of compilations of terminated pregnancies. Efforts to reconstruct abortion rates from this source are also fraught with limitations, most notably the inconsistency in the classification and reporting of cases of post-termination complications across facilities and populations, the difficulties involved in computing from available information the ratio of all induced abortions performed to the cases of compilations seen at hospitals, and the possible selectivity of cases seen in hospitals (Barreto *et al.*, 1992, Singh *et al.*, 1991).

There are few recent studies where the authors have tried to develop new methodologies to collect data on induced abortion. Huntington (1993) and Anderson (1994) have made such attempt to develop indirect interview technique in which questions are asked about abortion in the context of unwanted pregnancy and is holding promise for increasing the response rate. Huntington (1996) has reviewed the mix results from multicountry studies that have used the indirect interview technique. He has suggested exploratory qualitative studies to identify setting specific context for discussing abortion.

There are other studies which have attempted methodologies to extract information about induced abortion from different data bases, and estimate induced abortion rate. Rutenberg *et al.*, (1994) has attempted with DHS data. An attempt to detect induced abortions from reports of pregnancy terminations in DHS calendar data, has been made by Magnani *et al.* (1996). They have considered whether pregnancy terminations reported in Demographic and Health Survey (DHS) calendar data can be classified accurately as having been spontaneous or induced, based upon other information collected in the survey interview. A classification scheme has been proposed on the lines of the W.H.O. for categorising cases in which women admitted to hospitals experienced complications of pregnancy terminations (WHO, 1987). The evaluation of their methodology with Turkey DHS (1993) data indicates that the method identifies true cases of induced abortions accurately but tends to classify a relatively large number of reported spontaneous terminations as induced abortions. However, when they have got it corrected for likely respondent misreporting of induced abortions as spontaneous terminations, both the sensitivity and specificity of the method appear to be acceptable.

Bongaarts and Potter (1983) in their aggregate fertility model have indicated an indirect method of estimating 'Total Abortion Rate'. They have defined Total Abortion Rate (TA) as the average number of induced abortions per woman at the end of the reproductive period if induced abortion rates remain at prevailing levels throughout the reproductive period. The decomposition of TFR is as,

$$TFR = C_m * C_c * C_a * C_i * TF$$

where, C_m , C_c , C_a , C_i are indices of marriage, contraceptive use, induced abortion and post-partum infecundability respectively, and TF is Total Fecundity, taken to be 15.3

for practical purposes.

If one knows the values of TFR, C_m , C_c , C_i then C_a can easily be calculated. Again C_a is expressed as,

$$C_a = \frac{\text{TFR}}{\text{TFR} + 0.4(1+u)\text{TA}}$$

where, u is the current contraceptive prevalence in the population. Knowing C_a from decomposition formula, one can easily calculate the value of TA for the population from the above equation. The only shortcoming of this method is that it gives Total Abortion Rate, not simple abortion rate. However, this method is very useful and can be used extensively for the purpose of getting an idea of prevalence of induced abortion in a population. As the method does not use abortion data directly, it can also be quite useful in detecting extent of under reporting of induced abortion in a population from survey data.

Following the decomposition technique of Bongaarts and Potter (1983), Foreit and Nortman (1992) provide another method for calculating rates of induced abortion. Foreit and Nortman's method uses input of observed marital fertility rate, and contraceptive prevalence and produces age specific marital induced abortion rate in the population. The method is of the form:

MASAR = A/ BAA, where,

MASAR = Marital Age Specific Abortion Rate

BAA = Birth Averted by one induced abortion = $0.4(1 + U.e)$

A= Birth Averted by induced abortion, expressed as a rate per woman
= MF.L - PF, where,

MF = Biological maximum fertility rate (theoretical)

L= Index of postpartum infecundability (similar as C_i , defined by Bongaarts and Potter (1983)).

PF = Potential fertility = Fertility in the absence of contraception
= MASFR + C, where,

MASFR = Marital Age Specific Fertility Rate

C = Births averted by contraception, expressed as a rate per woman

U = Contraceptive prevalence expressed as a proportion of married women in the age group using contraception, and

e = Average contraceptive effectiveness.

The method is validated for three cities of South America against observed abortion complications. A great advantage of this method is its usefulness in projecting the impact of substituting contraception for abortion, which can be extremely handy for the family planning project planners, especially when the problem of unwanted fertility causes maximum induced abortion. On the other hand, like Bongaarts model, it depends on the precision of measurement of observed fertility and contraceptive prevalence as well as on the validity of the estimates of maximum biological fertility

and of the effectiveness of use of different contraceptive methods.

In the period, when Bongaart's decomposition model (Bongaart *et al.*, 1983) was not available, Kumar (1974) made an early attempt to estimate rates of pregnancy, foetal death, and induced abortion jointly with internal consistency. His method basically uses the proportions of conceptions resulting in live births (x), foetal deaths (y), and induced abortion (z), by writing,

$$x + y + z = 1$$

The pregnancy rate (R) and the general fertility rate (G) can be related by the identity:

$$G = \frac{Rx}{100 + bR}$$

where, b is the average number of years of non-exposure following a conception, i.e., the sum of the gestation period and post partum sterility, and thus,

$$b = l_1 x + l_2 y + l_3 z$$

where, l_1 , l_2 , l_3 are the average number of years of non-exposure, following, respectively, a live birth, a fetal death and an induced abortion. He has used the estimates of l_1 , l_2 , and l_3 given by Potter (1963).

Using the above three equations, the parameters defined earlier have been estimated jointly. He has demonstrated his method for Japan and USA. He has tabulated the percentages of conceptions resulting in foetal deaths, abortions and live births for the two countries.

The method is good and simple one but suffers from the problem of imperfect assumptions regarding length of gestation and also direct use of data of number of years of non-exposure, which are generally erroneous.

However, no study has been found in literature which gives methodology to calculate parity specific rate of induced abortion. The knowledge of parity specific abortion helps planners in a great way. The present study attempts at bridging that gap in abortion research.

The Model

In standard life table terminology l_x represents the life table survivorship schedule, i.e., the proportion of persons surviving to exact age x, and μ_x represents instantaneous death rate at exact age x. Then,

$$l_x = \exp \left\{ - \int_0^x \mu_y dy \right\} \dots\dots(1)$$

where, l_0 , the radix of the life table, is unity.

A suitable re-interpretation of the terms has been done to apply the same

concept in the case of parity progression. In the present context, let l_x denote the proportion of women of parity i who do not have a $(i+1)^{st}$ birth within x years of their i^{th} birth, and μ_x the rate of $(i+1)^{st}$ birth for these l_x women with x years of duration in i^{th} parity. So, if we write $l_x = 1 - p_i(x)$ and $\mu_x = b_{i+1}(x)$, for progression from parity i to $i+1$ following Feeney (1983), equation (1) can be written as,

$$1 - p_i(x) = \exp\left[-\int_0^x b_{i+1}(y)dy\right] \dots (2)$$

where, $p_i(x)$ is the proportion of women who had an $(i+1)^{st}$ birth within x years of their i^{th} birth and $b_{i+1}(x)$ is the rate at which these women have $(i+1)^{st}$ order births.

The parity progression ratio for progression from i^{th} to $(i+1)^{st}$ birth (p_i) can thus be written as

$$p_i = 1 - \exp\left\{-\int b_{i+1}(x)dx\right\} \dots (3)$$

for $i = 0, 1, 2, \dots$

where the integration is extended over the non-zero domain values of $b_{i+1}(x)$. Thus $b_{i+1}(x)$ can characterize the fertility of population of parity i women. The present model makes use of the equation (3). Let us assume, that, equation (3) corresponds to a situation when there is no practice of induced abortion. Now, if the rate of induced abortion among parity i women rises to a level say $TA_i (>0)$ with corresponding use of effective contraception u_i , fewer $(i+1)^{st}$ birth will occur lowering $b_{i+1}(x)$ and thereby decreasing p_i value, i.e. parity progression ratio. We thus can write equation (3) explicitly by introducing TA_i , the parity specific abortion rate, and u_i , the parity specific contraceptive prevalence as,

$$p_i(u_i, TA_i) = 1 - \exp\left\{-\int b_{i+1}(x, u_i, TA_i)dx\right\} \dots (4)$$

where, $p_i(u_i, TA_i)$ and $b_{i+1}(x, u_i, TA_i)$ are respectively the resulted parity progression ratios and schedule of parity specific birth rates when i^{th} parity women are practicing induced abortion at the level of TA_i and parity specific prevalence of effective contraception is u_i .

To have a relation between $p_i(u_i, TA_i)$, u_i and TA_i the following simple assumption has been made,

$$b_{i+1}(x, u_i, TA_i) = I_i \cdot b_{i+1}(x, u_i) \dots (5)$$

where, I_i = Index of induced abortion for parity i women and $b_{i+1}(x, u_i)$ is the i^{th} parity specific birth rate in the absence of practice of induced abortion.

Regarding the number of births averted per induced abortion, Potter (1972) has observed that on average an induced abortion averts less than one birth. He argues that an induced abortion may be unnecessary, because, a spontaneous abortion or still birth would have prevented the pregnancy from ending in a live birth. Further, with an induced abortion the period of infecundability gets considerably shortened. He also shows that number of births averted per induced abortion is by and large independent of

the age of woman while it is very strongly related to the practice of contraception following the induced abortion. In the absence of contraception, an induced abortion averts 0.4 births while in its presence, the number of births averted is 0.8. In general, if u_i is the prevalence of effective contraception among i^{th} parity women, then number of births averted per induced abortion among i^{th} parity women would be approximately,

$$BA_i = 0.4 (1 + u_i) \quad \dots(6)$$

Now, if it is assumed that a particular woman will not give more than one live birth in a year, $p_i(u_i, TA_i)$ can be interpreted as the number of live births occurred per woman in the year. So, in the absence of abortion, total number of live births per woman in that year would be $p_i(u_i, TA_i) + BA_i \cdot TA_i$. The effect of induced abortion can thus, ideally be expressed by writing I_i as,

$$I_i = \frac{p_i(u_i, TA_i)}{p_i(u_i, TA_i) + 0.4 \times (1 + u_i) \times TA_i} \quad \dots(7)$$

Using equation (5), equation (4) can be modified to

$$\begin{aligned} p_i(u_i, TA_i) &= 1 - \exp \left\{ - \int I_i b_{i+1}(x, u_i) dx \right\} \\ &= 1 - \left[\exp \left\{ - \int b_{i+1}(x, u_i) dx \right\} \right]^{I_i} \\ &= 1 - [1 - p_i(u_i)]^{I_i} \quad \dots(8), \end{aligned}$$

(using equation (4))

where, $p_i(u_i)$ is the i^{th} parity progression ratio in the absence of induced abortion, when, level of effective contraceptive use among parity i women is u_i . Thus, putting the expression for I_i (from equation (7) in equation (8), the final model is as below,

$$p_i(u_i, TA_i) = 1 - [1 - p_i(u_i)]^{\frac{p_i(u_i, TA_i)}{p_i(u_i, TA_i) + 0.4 \times (1 + u_i) \times TA_i}} \quad \dots(9)$$

The above model can not be validated from the available data. The model is thus, solely validated by sequential logic. It contains single parameter $p_i(u_i)$. Any application of the model needs estimating $p_i(u_i)$ in that context. Once the parameter is estimated, TA_i can easily be calculated from the above equation (equation 9). No direct or indirect method is presently available for estimating $p_i(u_i)$. In the present work, for the purpose of illustrating the model, this parameter is estimated directly from the information on births and life time experience of induced abortions of women. To this cause, the parity progression ratios have been calculated from the birth history data, after eliminating all women who had ever experienced induced abortion. The assumption underlying is that the group of women left after elimination constitute a representative sample of a population where practice of induced abortion is non-

existent. However, such assumption is hardly close to reality, because, the women those are eliminated would mostly be a group of high age, parity and potent women. Such method of estimating $p_i(u_i)$ also suffers from the problem of misreporting by the respondents of any induced abortion as spontaneous abortion. Hence, the estimates of the parity specific induced abortion given in the next section are approximate only, and most probably underestimates. However, the estimates may be taken as sufficiently correct for the purpose of illustrating the model and also for exploring the type of relationship that exists between parity and induced abortion rate.

Application of the model and discussion

The model described in the previous section has been illustrated here for India and three selected states, *viz.* Uttar Pradesh, West Bengal and Tamil Nadu. The more interesting feature that would be worth observing is not the actual estimates, but the shape of the curves over parity, which is unknown till date.

Data containing information on the socio-economic background, marital history, fertility history and contraceptive use of ever married women age 15-49 are obtained from the National Family Health Survey (NFHS), conducted almost all over India during April 1992 and September 1993 under the guidance of International Institute for Population Sciences, Bombay, India. Apart from the country as a whole, three states have been selected for this study, *viz.* Uttar Pradesh, West Bengal and Tamil Nadu. These three states represent three different levels of fertility and mortality transitions, modernisation and social development, which have been principal reasons behind their selection to include in the study.

India, constituting of diverse societies, cultures, traditions, languages, and religions, is a demographically moderate country, and is in the second stage of demographic transition. With a population nearing 90 crore in 1991, India has so far achieved a moderate TFR (3.4), though Infant Mortality Rate is as high as 78.5. Education among females in the country is too low (16.1 per cent with more than primary education), and average age at which females marry is mere 20 years. Though Government of India has targeted a Couple Protection Rate of 60 percent by the year 2001, the country's performance has been rather poor in this direction as only around 40 per cent of currently married women (13-49) are using a contraceptive method by 1992-93. The country is mainly agriculture based and around three fourth of the population live in rural areas.

The three selected states differ widely in geographical location, socio-economic conditions, ethnicity and demographic characteristics. Uttar Pradesh is a demographically backward province, with only around 12 per cent of women having more than primary education and the singulate age at marriage for females as low as 18.6 years during 1992-93. The total fertility rate is of around 5 and the infant mortality rate equalling about 100. The proportions of currently married women within reproductive age span using a method of contraception is quite poor (19.8) in this state. On the other hand, Tamil Nadu places itself on a moderately higher socio-economic background than Uttar Pradesh with total fertility rate and infant mortality rate on much lower side (2.52 and 67.7 respectively). Almost 50 per cent of currently married women

in 15-49 age group are using contraception. West Bengal stays in between Uttar Pradesh and Tamil Nadu. Current contraceptive use (57.4) in this state is even higher than Tamil Nadu but the use of modern methods is considerably lower (IIPS, 1995).

Estimates of the parameter of the model

Table 1 presents the estimates of the parity progression ratios in the absence of induced abortion (per woman) for India and the selected states. The results hint at high induced abortion rate, if compared with appendix table 1, which presents period parity progression ratios for the year 1992 for the same populations. However, for all four populations, progression ratios decline almost steadily from parity one. Thus the slope of parity progression curves does not change much in the absence of induced abortion. However, the relative change in the magnitude is substantial for medium parities (if compared with appendix table 1), which probably indicates that maximum induced abortion takes place at medium parities (2-4).

Parity	Uttar Pradesh	West Bengal	Tamil Nadu	India
0	0.9641	0.9679	0.9073	0.9430
1	0.9765	0.8100	0.9763	0.9115
2	0.8350	0.7555	0.6204	0.7335
3	0.7307	0.6990	0.4140	0.5644
4	0.6374	0.6024	0.4513	0.5231
5	0.6823	0.6910		0.4794
6	0.6932	0.4909		0.5296
7	0.5967			0.4973
8	0.5829			0.4036

Note : Calculated by using Feeney's method (Feeney, 1984), by eliminating those women who had ever experienced induced abortion.

Model estimates of parity specific induced abortion rates

Using table 1, appendix table 2, along with equation 9, the parity specific induced abortion rates have been calculated for India and three selected states and are presented in table 2. The estimates have also been plotted against parity and are shown in figure 1.

The table reveals that for all relevant states, as well as, for India, induced abortion rates first increase with parity and then at medium to high parities start declining. The point of change depends much upon the overall fertility of the corresponding population. For Tamil Nadu, a low fertility state, induced abortion rate is quite high even at parity zero (8.2), increase to around 18 by parity 2 and then decline to mere 4 at parity 4. The high rate of induced abortion at zero parity may be because, most of the women in Tamil Nadu wish to have a long interval before first birth. In Tamil Nadu, the maximum percentage of induced abortions happen to occur among parity 2 women; a parity very close to their average ideal family size. The rate of induced abortion then falls down, probably because in Tamil Nadu, most of the women

get themselves sterilised after second parity. Hence, the relationship between parity and induced abortion rate takes a parabolic shape, and peaks at parity 2.

The basic relationship is found to be the same for other three populations, except for the varying parity at which they peak, and the slope with which they rise or fall. Likewise, for West Bengal, induced abortion rate peaks at parity 3/4 and then falls. It ranges from 1.6 to 11.5 to 6.7. In West Bengal, as traditional methods of contraception are more popular (IIPS, 1995), the induced abortion rate was expected to be higher at least at initial parities. But, the results do not support such hypothesis and probably indicate an extensive underreporting or misreporting of induced abortion. This point gets strong base when it is observed that the actual fall in induced abortion starts at parity 5, while the mean ideal family size is only 2.6 and mean parity at sterilisation is around 3. However, it may be because of the probable error in estimation of parameter of the model.

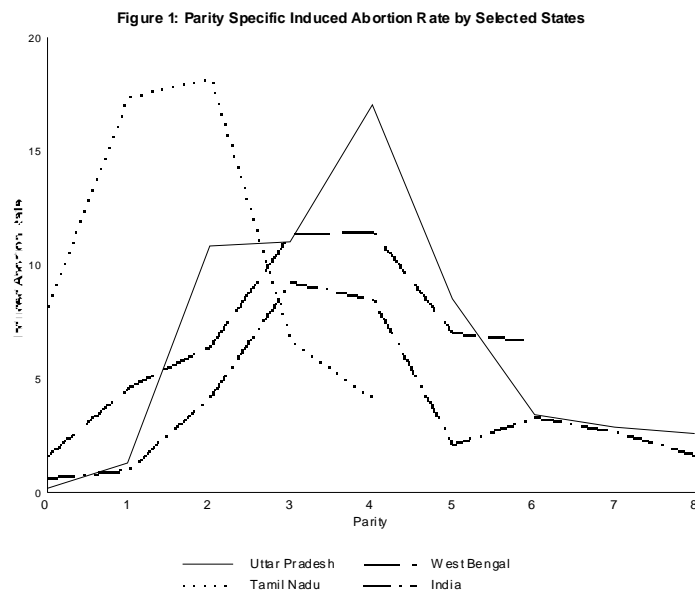
Table 2 : Model estimates of Parity Specific Induced Abortion Rate, India and three selected states, 1992

Parity	Uttar Pradesh	West Bengal	Tamil Nadu	India
0	00.14	01.64	08.21	00.66
1	01.30	04.66	17.39	00.99
2	10.83	06.52	18.20	04.22
3	11.01	11.36	06.67	09.27
4	17.08	11.52	04.21	08.49
5	08.56	07.05		02.14
6	03.46	06.70		03.29
7	02.85			02.70
8	02.63			01.69

Note : Calculated by using table 1, appendix table 2 and equation 9

It can be observed from the table 2 that in case of Uttar Pradesh and India, induced abortions at parity 0 and 1 have been very rare. Quite unexpectedly, Uttar Pradesh shows a large escalation in abortion rate as early as at parity 2 (10.83), and it continues to be high up to parity 4 (17.08), before declining fast to mere 2.63 at parity 8. Though for the country as a whole, the peaks and falls are quite similar to Uttar Pradesh, the extent of induced abortion is much less. High fertility, low contraceptive use, as well as moderately high induced abortion rate at medium parities in Uttar Pradesh suggest that a large unmet need for family planning services exists in the state.

From figure1 the facts are clearer. The shape of the curves are similar for all the populations concerned. While, the differences are largely in their point of peak, peakedness, and upward and downwards slopes.



Summary and conclusions

In this study, a parity progression model has been developed using life table concept. The model relates observed period parity progression ratio to use-effectiveness adjusted parity specific current contraceptive prevalence, and parity specific induced abortion rate. It contains a single parameter, namely, 'parity progression ratio in the absence of induced abortion'. From application following observations are made:

1. For all the populations considered, the relationship between parity and rate of induced abortion has been found to be parabolic with its peak at varying parities, depending upon the level of fertility of the corresponding population.
2. The peakedness of the curves and the slopes also vary with population.
3. Tamil Nadu has been found to have maximum rate of induced abortions at parity 1 and 2, where that in case of Uttar Pradesh has been 4. West Bengal shows less than expected rate of induced abortion.

Notwithstanding the limitations of the model, for policy makers, it is very important to know the exact extent of induced abortion at different parities to facilitate the parity specific projections. For, family planning programme managers, this model can provide useful information about the possibility of getting more acceptors and the possible target groups. The model can be of great help to Reproductive Health research, because, knowing the exact extent of the problem of

induced abortion for different population groups is of primary importance.

However, the model needs more refinement. It will not be much sensitive to the error of estimation of use-effectiveness adjusted contraceptive prevalence. But, in case of estimation of the parameter, one should be very cautious on the precision of the estimate. Hence, a new refined method (other than one used here) of estimating period parity progression ratios in the absence of abortion may well enhance the performance and usefulness of the model.

APPENDIX TABLES

Appendix Table 1 : Period Parity Progression Ratio (per 1000 women) for India and three selected states, 1992

Parity	Uttar Pradesh	West Bengal	Tamil Nadu	India
0	964	967	899	959
1	976	800	968	928
2	817	737	553	748
3	704	659	380	598
4	586	556	431	556
5	680	562		516
6	684	461		536
7	588			497
8	501			404

Appendix Table 2 : Percent use-effectiveness adjusted current contraceptive use by parity, women aged 15-49, India and three selected states, 1992

Parity	Uttar Pradesh	West Bengal	Tamil Nadu	India
0	1.47	15.22	2.43	3.15
1	5.82	36.80	21.43	14.84
2	14.95	54.44	54.22	40.39
3	24.10	68.19	68.08	55.33
4	28.95	64.05	64.90	56.07
5	27.97	65.28	65.72	54.41
6	26.92	58.72	57.03	48.21
7	23.51	43.67	55.69	40.37
8	22.78	48.22	51.77	34.69

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