



## ECONOMIC EVALUATION OF THE MOST EFFECTIVENESS COST OF SCREENING WAY BEFORE BIRTH OF DOWN SYNDROME AT FIRST TRIMESTER

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### ABSTRACT

**Introduction:** Economic evaluation comprises essential evaluation of costs and benefits of screening. One of the ways of economic evaluation is analyzing effectiveness cost. The purpose of this study is economic evaluation of the most effectiveness cost of screening ways before birth of Down syndrome at first trimester in the city of Shahrekord. **Method:** This study is an analytical-descriptive with calculating effectiveness cost of two ways in nuchal translucency (NT) by ultrasound and biochemistry of mother's serum, measuring protein

A related to pregnancy and human chorionic gonadotropin during first trimester of pregnancy. Total pregnant women who have performed screening tests during first trimester were 357. **Findings:** The cost of the most effectiveness way of screening Down syndrome is on the first trimester of ultrasound (ratio of effectiveness cost 3729080 rials for prevention from each Down syndrome). Meantime, mother's age represented a meaningful relation to the results related to the birth of Down syndrome infant ( $P=0.012$ ). **Conclusion:** Between 357 pregnant women which have performed first trimester screenings, 10 Down syndrome infants were identified. Number of identified infants who had Down syndrome did not correspond to results of first trimester screening. It was more diagnosed that in two ways births of Down

syndrome infants were low and doesn't indicate exact results to the investigators. As a result, we can't rely on this two ways as comprehensive and definitive diagnostic ways and screening ways during second trimester recommended.

**KEYWORDS:** Down syndrome, effectiveness cost, ways of screening during first trimester.

## INTRODUCTION

Aneuploidies are the main reasons of prenatal mortalities and disabilities in childhood. At least 8% of pregnancy products are aneuploidies and these numbers are responsible for 50% of first trimester abortions and 5-7% of all cases are considered stillbirths and natal mortalities.<sup>[1]</sup>

Meantime, Down syndrome or mongolism with limited way, 1 case in births of 700 infants, has been recognized as the most common chromosome disorder (2). In the years 1970, the main way in aneuploidy screening was by mother's age. The age singly is a weak criterion for screening, because almost 70% of pregnancies with Down syndrome occur in women below 38 years old.<sup>[1,2]</sup>

In the past 15 years, many progressions were performed in screening of Down syndrome embryo.<sup>[3]</sup> These screening tests totally are divided in three categories: First trimester tests, second trimester tests and composition of both.<sup>[4]</sup> When it was specified that high numbers of embryos are detectable with serious aneuploidies by composition of mother's age, NT and measuring pregnancy-associated plasma protein-A (PAPP-A), concentration on first trimester became more.<sup>[5]</sup> Screening of first trimester identifies 90% of embryos with trisomy 21 and other important aneuploidies with 5% positive and false rate.<sup>[6]</sup>

The purpose of prenatal Down syndrome screening is identifying women with high risks of having unhealthy child to confirm presentation of a diagnostic test and if positive, they have the chance to ending the pregnancy.<sup>[7]</sup> In the past 10 years, many additional ultrasonic indicators have been used that amend detection of aneuploidies and reduce positive and false rate.<sup>[6]</sup> Although many options exist for screening prenatal Down syndrome, there isn't an unique idea about cost of the most effectiveness way.<sup>[8]</sup>

Between different ways of screening, first trimester screening have been significantly increased. In Britain and other parts of Europe, a screening approach of first trimester with ultrasound and biochemistry screening is common, while in America screening of mother's

serum in second trimester for Down syndrome embryo is a standard way.<sup>[5,9,10]</sup> However, there are different ideas about ways of screening that should be proposed to pregnant women.<sup>[3,4,8]</sup> Dangers and benefits of each way in various societies have been reported.<sup>[3]</sup> Compound screening is so effective (90% of recognition rate or positive and false rate of 5%). Its relative simplicity leads to completion of the prenatal diagnostic process in the first trimester.<sup>[11]</sup> Gekas and colleagues found that compound screening has the most ratio of effectiveness cost and the most rate of abortion because of diagnostic ways (n=71).<sup>[3]</sup> Wald and colleagues stated that efficiency of screening in the first and second trimesters of pregnancy is separately the same and efficiencies of both compared to test efficiency that inserts evaluation of screening in the first and second trimesters, have lower effectiveness.<sup>[12]</sup> In this paper, the main aim is economic evaluation the cost of most effectiveness screening ways prenatal Down syndrome in first three months.

## METHODOLOGY

This paper was an analytical-descriptive study of economic evaluation of effectiveness cost and NT by ultrasonic and biochemistry of mother's serum, evaluating protein A related to pregnancy and human chorionic gonadotropin during first trimester of pregnancy in Shahrekord.

This research is the first study related to this field in Iran and because of the economic importance of Down syndrome births has been noticed. Statistical society of this study include all pregnant women who have done screening tests at first trimester. Required determination of sample size have done according to statistical universe of women in pregnancy age in Shahrekord who were 68708 women.

$$\varepsilon = 0.1 \quad z_{1-\frac{\alpha}{2}} = 1.96 \quad p = 0.5 \quad \alpha = 0.5$$

$$n = \frac{N \times Z^2 \alpha_{/2} \times P(1 - P)}{\varepsilon^2(N - 1) + Z^2 \alpha_{/2} \times P(1 - P)}$$

According to 68708 women of statistical universe in pregnancy age, sample size were determined 357.

Required data in this study include demographic information of pregnant mothers, information related to the results of screening and cost information. Cost of effectiveness was

calculated by determining paid costs according to the patient (quantitative and independent unit) and ratio of diagnoses of Down syndrome in each way.

Cost for diagnosis of each Down syndrome= (cost of method A –cost of method B) divided to (effectiveness of interference A) – (interference of effectiveness B)

Regarded demographic data in this study were mother's age, mother's education, family marriage, father's addiction and history of disorder. The relations of these variables to birth of Dawn syndrome infant by software SPSS have been investigated. This paper is focused on analyzing costs and results from patient's viewpoint.

Screening costs and NT are calculated by ultrasound and biochemistry of mother's serum, measuring Protein A related to pregnancy and human chorionic gonadotropin in first three months of pregnancy by patient's bill and reported costs by patients in the time of birth. Whereas, because of lack of affecting related to insurance in reducing costs, the insurance has not been regarded.

In this study, because of complexity of evaluation and lack of trusting information related to costs, calculations of indirect costs were ignored. Number of diagnoses according to results of tests reports don't indicate effectiveness. After collecting and classifying costs, Excel application and Treeage software were used for analyzing effectiveness cost. Furthermore, information related to effectiveness of cost estimate were gained by determining costs from the perspective of patient (quantitative and independent unit) than number of Down syndrome diagnoses in each method.

## RESULTS

In this section, at first it is proceeded to demographic features of pregnant women who have done the screenings of the first trimester, separately mother's age, mother's education, family marriage, father's addiction and history of disorder. Totally 357 people who have done the first three months screening ways, have been participated. In this issue, the most frequency of mother's age was in range 30.6 (30.4=+ 5.2). 273 (76.5) were above 30 years old and 47.1% had educations above diploma. In these methods, 10 had Down syndrome. 2.8% were suspicious and only 20% of them have been properly recognized.

**Table 1: Correlation of variables with birth of Down syndrome infant.**

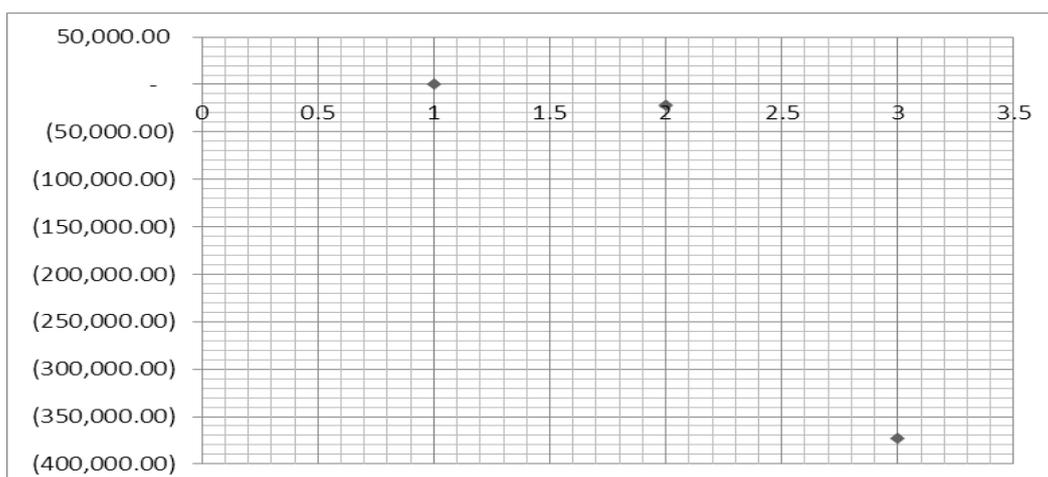
Specifications	Yes Frequency (percentage)	No Frequency (percentage)	P (value)
Mother's age: 35< 35>	(1.5)4 (7.3)6	(95.5)269 (92.7)76	0.012
Mother's education: diploma< diploma diploma>	(7.8)4 (1.5)2 (2.4)4	(92.2)47 (98.5)135 (97.6)164	0.075
Addiction of spouse: has Doesn't have	(4.9)4 (3.2)6	(95.1)78 (97.8)269	0.278
History of anomaly infant: has Doesn't have	(20.0)1 (2.6)9	(80.0)4 (97.4)343	0.133
Result of ultrasound: suspicious normal	(20.0)2 (1.9)6	(80.0)8 (98.1)306	-
Result of blood test (multiple): suspicious normal	(14.3)3 (2.4)6	(85.7)18 (97.6)245	-

Mother's age showed a meaningful relation with results of Down syndrome birth ( $P=0.012$ ). In screening through ultrasound, between 10 identified cases of Down syndrome, only 20% have been diagnosed exactly and screening of blood test (multiple), 14.3% of 10 identified items have been properly diagnosed (table 1).

### Tornado diagram

Left side: costs

Below the diagram: Effectiveness.



**Table 2: Cost for birth of an infant with Down syndrome.**

Variable / method	Cost (rial)	Effectiveness	Ratio of effectiveness cost (rial)
Ultrasound screening A	717500	0.2	3729080
Screening of multiple blood test B	930590	0.14	3729080

Results of analyzing effectiveness cost have been summarized in table 2. The cost of the most effective way of Down syndrome screening is on the first three months in ultrasound (ratio of effectiveness cost is 3729080 for preventing each Down syndrome).

## DISCUSSION

One of the known chromosome abnormalities is Down syndrome.<sup>[1,13]</sup> Screening for embryonic chromosome abnormalities is one of the necessary cares before birth. Many tests have been performed during two previous decades and have caused increase in detecting chromosome disorders as Down syndrome. Some of these tests prepare the chance for screening before twentieth week of pregnancy. Ways of measuring NT by ultrasound and biochemistry of mother's serum, measuring protein A related to pregnancy (PAPP-A) and hCG during the first trimesters are suitable measurement ways for investigating prenatal Down syndrome.<sup>[14]</sup> The benefit of these screening methods is early diagnosis and we can do the confirming tests later. So, if necessary, we can end the pregnancy in lower ages. This issue is along with lower danger and staying private of that case.<sup>[7]</sup> In this case, attempts are significant for increasing effectiveness of screening ways according to its economic costs. Evaluation of usefulness related to prenatal Down syndrome screening will cause costs originated from Down syndrome birth about personal or social aspect.<sup>[15]</sup> This study with the aim of cost related to the most effectiveness way of screening during the first three trimester, evaluated NT method by ultrasound as more effectiveness cost and estimated ultrasound method with higher effectiveness and lower cost. Results of this analysis showed that the cost for each preventive item from Down syndrome with NT method by ultrasound is 3729080 rials. Many economic evaluations have performed on screening methods of Down syndrome which indicate in the first three months screening, there are considerable saves in costs.<sup>[4, 5]</sup> However, Gekas and colleagues stated that coherent screenings have higher effectiveness than screening on the basis of mother's age.<sup>[3]</sup>

Our one-way sensitivity analyses also indicate that this model despite wide rates of changes on variables, again show NT method by ultrasound as dominant and also this method is

useful in preventing performance of unnecessary diagnostic ways.<sup>[4]</sup> Our findings are various with performed studies on Down syndrome. According to the study of Vintzileos, they compared common ways of screening in Britain as NT and America as the second three months serum which the second-trimester serum was the most economic method.<sup>[16]</sup> Caughey reported that the most economic method of screening in the first trimester performs by NT and serum.<sup>[4,17]</sup> Gilbert and colleagues stated that NT method is more effective than multiple method.<sup>[18]</sup>

In different ways of screening related to Down syndrome during first trimester, Munoz declared that its relative simplicity has led to completing prenatal diagnostic process during first trimester<sup>[11]</sup> and according to the study, these two methods are complementing each other.<sup>[4]</sup> Analyzing the study indicated that mother's age has a meaningful relation to the infant's birth who have Down syndrome. Various studies have confirmed this issue.<sup>[13, 19]</sup> Selection between different ways of screening depends on that the willingness of service providers to paying cost in preventing birth of an infant with Down syndrome.

## CONCLUSION

According to high costs of an infant with Down syndrome and economic issue in their maintenance by their family or society, choosing suitable screening ways to reducing birth of an infant with Down syndrome are necessary and it is suggested that screening methods during second trimester also should be evaluated and the cost of the most effectiveness method to reducing economic pressure should be chosen and to persuade insurances and decision-makers of health system to support the most effectiveness method. According to this study which has performed in a small city as Shahrekord, it is suggested to be examined in big cities considering skills of experts in ultrasound and quality of experimental devices.

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