Original Article

Immunomodulatory activity of *Swarna Prashana* (oral administration of gold as electuary) in infants - A randomized controlled clinical trial

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Abstract

Background: *Swarna Prashana* (oral administration of gold as electuary) is a form of electuary depicted in the classics of Ayurveda under the ambit of pediatrics. A specific action on immune system has been highlighted in infants if gold is administered along with *Ghrita* and honey for a period of 28 days. **Aim:** The present trial was conducted to assess the safety and efficacy of *Swarna Bhasma* (calcined powder), *Madhu* (honey) and *Ghrita* in infants with respect to anthropometrical, hematological and immunological parameters. **Methodology:** The trial was a randomized, controlled, single-blind study in 102 healthy infants allocated into trial and control groups. Trial group received a mixture of *Swarna Bhasma*, honey and *Ghrita*, while control group received a mixture of honey and *Ghrita*, both in drops form for a period of 4 weeks with 8 weeks follow-up. Safety was assessed on the basis of biochemical parameters and efficacy was based on the values of IgG before and after the treatment. **Results:** Anthropometrical and biochemical parameters did not showed any statistically significant difference between the effect of trial and control drugs, which suggested that the trial drugs did not hamper normal growth of the infants and were safe to be administered in infants. Both trial and control drugs showed statistically significant changes in IgG levels individually before and after the treatment; however, when compared between the groups, there was no significant differences. However, the number needed to treat (NNT) to assess the normalization of immunoglobulins, which is suggestive of its immunomodulatory activity, was 1 out of every 4.535 infants who received *Swarna Prashana* which was significant. **Conclusion:** *Swarna Prashana* did not interfere with normal growth of the infants. As evident by NNT, it showed immunomodulatory activity and was tolerated by the infants with no adverse effects during the trial or follow-up period.

Keywords: Gold electuary, immunomodulator, *Jatakarma*, *Lehana*, *Swarna Prashana*

Introduction

Swarna Prashana (oral administration of gold as electuary) is a unique practice documented in Ayurveda under the field of child healthcare. Kashyapa Samhita, which is the authoritative textbook of *Kaumarabhritya* (pediatrics), depicts this unique formulation under the context of *Lehana* (licking procedure by electuary). It has been explained that gold should be triturated along with water, honey and *Ghrita* on a pre-washed and clean stone; facing eastern direction and the mixture should be given to the *Shishu*/infant in a semisolid form.[1] Among the benefits attributed to this practice, its effects mentioned on *Medha* (intelligence quotient), *Agni* (digestion and metabolism) and *Bala* (physical strength and immunity) of an infant is noteworthy. As a specific outcome on the immune system in infant, it is mentioned that, it is capable of curing

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diseases with one month administration of formulations of gold.[1] Although there are many combinations of herbal drugs described under the same context, such time-bound efficacy is mentioned only for gold. In *Charaka Samhita*, under the context of *Jatakarma* (basic newborn care), administration of a mixture of *Ghrita* and honey to the baby by chanting spiritual hymns has been narrated which is said to be followed by the initiation of breastfeeding.[2] This procedure is also said to improve the physical strength and immunity and render healthy life to the newborn.

As a routine, *Swarna Prashana* is being practiced by clinicians in various permutations along with herbal drugs propagating vague claims which were not having scientific basis. This prompted the present study as a preliminary attempt to clinically evaluate the effect of *Swarna Prashana* with respect to immunomodulatory activity. The study was planned to compare the effect of *Swarna Prashana* containing gold along with *Ghrita* and honey as an immunomodulator in comparison to a mixture of only ghee and honey based on the above-cited references. The objectives of the study were to evaluate the safety and efficacy of the trial and control drugs in infants with respect to anthropometrical, hematological and immunological parameters.

Methodology

Study design

The study was a randomized, controlled, single-blind, single-center, parallel-group, phase II trial with pretest and posttest design.

Study settings and selection of subjects

Infants who fulfilled the criteria were included in the trial from the Outpatient and Inpatient department of *Kaumarabhritya* of IPGT and RA Hospital during the year 2013–2014. A computer-generated randomization chart[3] was used for random sampling. The trial was approved by the Institutional Ethics Committee (Approval No. PGT/7-A/Ethics/2011-2012/2796) before enrollment of the participants and was registered in the CTRI (CTRI/2012/03/002505). Written informed consent from the parents was obtained for including their children in the study.

Inclusion criteria

1. Healthy full-term infants aging one day to 12 months of either sex, irrespective of caste and socioeconomic status who are free from any disease and have normal growth (anthropometrical measurements) and developmental milestones with regard to their age.
2. Birth weight >2.5 kg.

Exclusion criteria

1. Premature and postmature infants
2. Infants with congenital abnormalities and those requiring emergency care
3. Infants with any systemic diseases which may turn out to be hindrance during the course of the study

Interventions

The participants included in the study were divided into two groups as follows.

1. Trial group received *Swarna Prashana* [Mixture of *Swarna Bhasma* (processed gold, honey and *Ghrita*)]
2. Control group received control drug (mixture of honey and *Ghrita*).

Complete physical examination and detailed evaluation of the included infants with respect to growth and development was done and documented in a specially prepared clinical research form.

Preparation of drug and dosage

Trial drug consists of *Swarna Bhasma* (calcined powder of gold), honey and *Ghrita*, whereas the control drugs only the mixture of honey and *Ghrita* in the same proportion as that of in trial drug. Dosage of *Swarna Bhasma* was fixed by following Fried's rule[4] by considering the adult dose of *Swarna Bhasma* as 30 mg.[5] *Swarna Bhasma* for preparing the formulation was procured from the department of Rasashastra and Bhaishajya Kalpana of the Institute. *Ghrita* and honey with Agmark grade were procured from local market.

Before preparation of the formulation, analysis of *Swarna Bhasma* with X-ray powder diffractometry, scanning electron microscopy-electron dispersive spectrometry and inductively coupled plasma-atomic emission spectrometry was carried out which revealed the presence of 93.52% of pure gold in the sample and the magnification photographs revealed the particle size ranging from about 1–10 μm. The tests did not reveal the presence of any other metals in the sample more than the permissible levels. Honey and *Ghrita* were tested for microbial contamination at Microbiology laboratory attached with the Institute.

The formulation was prepared with specific proportion (1:4 in drops) of *Ghrita* and honey so as to maintain the dosage form as drops. The fixed dosage as per the age [Table 1] was followed in infants once a day in the morning followed by feeding for

Table 1: Dosage of *Swarna Prashana* for different age groups

Age of infants in months	Dosage in drops per day	Approximate quantity of *Swarna Bhasma* in drops per day (mg)
1	1	0.2
2	2	0.4
3	3	0.6
4	4	0.8
5	5	1.0
6	6	1.2
7	7	1.4
8	8	1.6
9	9	1.8
10	10	2.0
11	11	2.2
12	12	2.4

a period of 28 days. Similar dose in drops was followed in control drug group as well.

Duration of the trial and follow-up

Duration of the study was 4 weeks with one review (at 2 weeks) in between. Follow-up was for a period of 8 weeks.

Laboratory investigations

The following laboratory investigations were assessed in all the infants before and after the trial.

Routine hematological investigations

1. Hemoglobin percentage
2. Total count of white blood cells
3. Differential count
4. Total red blood cells
5. Platelet count.

Biochemical investigations

1. Random blood sugar
2. Lipid profile
3. Liver function test (LFT)– serum glutamic pyruvic transaminase (SGPT), serum glutamic oxaloacetic transaminase (SGOT), serum albumin and alkaline phosphatase
4. Renal function test (RFT)– blood urea, serum creatinine, uric acid
5. Immunological profile – serum IgG.

Assessment of outcomes

The primary outcome of the trial was to record the changes in the values of immunological profile tests pre and post-trial. The secondary outcome of the trial was to assess the changes in anthropometry parameters to monitor changes in growth and liver and kidney function tests to rule out any toxic effects in the body. The overall outcome of the trial was assessed with the help of odds ratio[6] at the endpoint of the study. The end point was fixed as achievement of immune normalization by the infants at the end of the clinical trial. These outcomes were assessed in two age groups of infants namely < 1 month and 1–12 months. The reason behind the above method of analysis of data was to avoid the bias in interpreting the changes in parameters which vary physiologically in newborn (< 1 month) and infancy (1–12 months) period.

Observations

A total of 102 infants were enrolled in the study among which 81 completed the trial, among which 47 and 34 infants belonged to the trial and control groups, respectively. Total 21 infants dropped out from the study among which 9 and 12 were from trial and control groups respectively. Out of 102 infants enrolled in both the groups, 66 were male and 36 were female [Table 2]. In the study, the number of infants belonging to 1–12 months of age was more compared to that of < 1 month of age [Table 3]. Among the infants who completed the full course of the trial, hematological and biochemical investigations of a few infants were not included in the statistical analysis, owing to less quantum of blood sample drawn which was due to noncooperation of the parents regarding the repeated pricks to infants [Table 4].

Table 2: Gender-wise and average birth weight-wise distribution of infants

Group	Male (%)	Female (%)	Average birth weight (kg)
Trial	35 (62.5)	21 (37.5)	3.05
Control	31 (67.4)	15 (32.6)	3.10

Table 3: Age-wise distribution of infants who completed the full course of the study

Group	< 1 month	1-12 months
Trial	11	36
Control	13	21
Total	24	57

Mothers of all the infants in both the groups had regular antenatal checkup having the percentage as 100 in each group. 88.5% of the mothers did not suffer from any major illness during pregnancy, whereas 11.5% of the mothers suffered from major illness during pregnancy. 94.1% of the mothers consumed medications such as folic acid, vitamins, iron, calcium, and Ayurveda drugs, while 5.9% of the mothers did not consume medications during antenatal period. Among those who consumed medications, 56% were consumed Ayurveda medications. 99.01% of the mothers were vaccinated during pregnancy while 0.99% did not get vaccines. 68.6% of babies were born through normal vaginal delivery, 20.5% through indicated lower segment caesarean section (LSCS), 9.8% through assisted vaginal delivery (forceps and vacuum), and 0.98% through optional LSCS. Average birth weight of the enrolled infants was 3.075 [Table 2]. Out 23 infants in the trial group, 17 had normal dentition while 6 had delayed dentition. In control group, out of 22 infants, 15 had normal dentition while 7 had delayed dentition.

Results

Both the trial and control groups showed statistically highly significant ($P < 0.001$) effects on all the anthropometrical measurements of infants aged < 1 month and 1–12 months. However, on comparison, there was no statistically significant differences between the two groups [Tables 5 and 6]. On comparison with control, trial drug did not show any statistically significant difference on hematological parameters, except in increasing lymphocyte count and decreasing eosinophil count ($P < 0.05$) of infants aged < 1 month. In biochemical parameters too, no statistically significant changes were noted including LFT and RFT of the infants aged < 1 month [Tables 7 and 8] and 1–12 months [Tables 9 and 10]. Statistically significant effect ($P < 0.05$) in decreasing serum IgG value was seen in infants aged < 1 month, whereas control drug did not show statistically significant effect. On comparison, no statistically significant differences were

Table 4: Details of missing hematological and biochemical data

Age group (months)	Trial group		Control group	
	Hematological investigations	Biochemical investigations	Hematological investigations	Biochemical investigations
0-1	1	2	2	2
1-12	5	6	2	3
Total	6	8	4	5

Table 5: Comparative efficacy of trial and control drugs on anthropometry in infants aged < 1 month

Parameter	df	Mean difference	SE	*t*	*P*
Weight (kg)	22	0.540	0.275	1.964	>0.05
Length (cm)	22	1.274	0.7679	1.659	>0.05
Head circumference (cm)	22	0.735	0.8803	0.835	>0.05
Chest circumference (cm)	22	1.303	0.9654	1.350	>0.05

df: Degree of freedom, SE: Standard error

Table 6: Comparative efficacy of trial and control drugs on anthropometry in infants aged 1-12 months

Parameter	df	Mean difference	SE	*t*	*P*
Weight (kg)	55	0.202	0.4561	0.443	>0.05
Length (cm)	55	0.586	1.7263	0.339	>0.05
Head circumference (cm)	55	0.233	0.7598	0.307	>0.05
Chest circumference (cm)	55	0.116	0.9203	0.126	>0.05

df: Degree of freedom, SE: Standard error

Table 7: Comparative efficacy of trial and control drugs on hematological parameters in infants aged < 1 month

Parameters	df	Mean difference	SE of mean	*t*	*P*
Hb% (g/dl)	19	−0.684	0.8143	0.840	>0.05
TLC (/cumm)	19	429.09	1189.70	0.361	>0.05
TRBC (x10^6)	19	−0.448	0.2855	1.569	>0.05
PLT count (lac/cumm)	19	17.436	60.984	0.286	>0.05
Neutrophil (10^3/cumm)	19	10.6	5.366	1.975	>0.05
Lymphocyte (10^3/cumm)	19	−16.527	5.5321	2.987	<0.05
Eosinophil (10^3/cumm)	19	2.918	1.044	2.794	<0.05
Monocytes (10^3/cumm)	19	0.009	0.423	0.021	>0.05

df: Degree of freedom, SE: Standard error, Hb: Hemoglobin, PLT: Platelet, TLC: Total leukocyte count, TRBC: : Total Red Blood Cell Count

found [Table 11]. Both trial and control drugs did not showed any statistically significant effect on immunological parameters of infants aged 1–12 months either individually or upon comparison [Table 12].

Overall outcome on immunomodulation in relation to number needed to treat

The results suggest that at the end of the study, 84.5% of the infants in the trial group and 60% of the infants in the control group showed normalization of IgG values. There was about 22.05% absolute risk increase in infants belonging to trial group in whom immune normalization had taken place when compared to control group. Relative risk (RR) increase was 36.8% and the odds ratio was 3.048. Number needed to achieve these results was 4.535 which was statistically significant ($P < 0.05$) [Tables 13 and 14].

Follow-up

During the follow-up study of 8 weeks, three infants in the trial group reported with episode of mild cough in the first follow-up and four infants in the control group reported with upper respiratory tract infection. During the full course of the study including follow-up period, no adverse drug reaction (ADR) was reported.

Discussion

Malnourished infants and children are known to have lower development scores compared with healthy subjects,[7] which suggest the importance of maintenance of optimum nutritional status of infants. The precise mention of *Swarna Prashana* in Ayurveda may also be due to some specific action of gold in infancy which was observed in the studies which measured gold in the human placenta and newborn liver at birth[8] and in newborn hairs.[9] This supports the insight of Acharya in considering gold as an essential element with some specific action in the human body.

In the present study, among the 102 infants registered based on the inclusion criteria, 21 discontinued the trial in between. The major reason for discontinuation was irregular follow-up and fear of prick to the infants. Comparatively, a smaller number of infants in the age group of < 1 month is suggestive of the major concern of parents/guardians to introduce a new drug in newborn period. 10.7% of the infants in the trial group and 15.2% infants in the control group had delayed dentition. Delayed dentition without any apparent associated illness may be due to hereditary causes or nutritional impairment during prenatal and natal period and in infancy and due to other various environmental factors.

Although statistically highly significant ($P < 0.001$) effects were seen individually in the trial and control groups on all anthropometric measurements of infants aged < 1 month and 1–12 months, on comparison, there was no statistically significant difference between the groups which was suggestive that both the drugs did not hamper normal growth of the infants and the trial drug did not have any additional effect on enhancing the anthropometrical values.

All the changes in the values of hematological parameters in infants aged < 1 month and 1–12 months were within normal limits, showing that trial and control drugs did not interfere

Table 8: Comparative efficacy of trial and control drugs on hematological parameters of infants aged 1-12 months

Parameters	df	Mean difference	SE of mean	*t*	*P*
Hb% (g/dl)	48	0.381	0.3475	1.096	>0.05
TLC (/cumm)	48	−650.713	969.55	0.671	>0.05
TRBC (x10^6)	48	0.143	0.1489	0.961	>0.05
PLT count (lac/cumm)	48	5.578	39.756	0.140	>0.05
Neutrophil (10^3/cumm)	48	1.747	2.2714	0.769	>0.05
Lymphocyte (10^3/cumm)	48	−1.6	2.4462	0.654	>0.05
Eosinophil (10^3/cumm)	48	−0.56	0.5292	1.058	>0.05
Monocytes (10^3/cumm)	48	0.026	0.2321	0.911	>0.05

df: Degree of freedom, SE: Standard error, Hb: Hemoglobin, PLT: Platelet, TLC: Total leukocyte count, TRBC: Total Red Blood Cell Count.

Table 9: Comparative efficacy of trial and control drugs on biochemical parameters in infants aged < 1 month

Parameters	df	Mean difference	SE of mean	*t*	*P*
RBS (mg/dl)	18	-0.76	4.965	0.153	>0.05
Serum cholesterol (mg/dl)	18	3.87	10.318	0.375	>0.05
Serum triglyceride (mg/dl)	18	-19.72	29.77	0.662	>0.05
HDL (mg/dl)	18	0.7	4.614	0.152	>0.05
SGPT (IU/L)	18	-6.321	6.04	1.046	>0.05
SGOT (IU/L)	18	2.871	8.34	0.344	>0.05
Total Bilirubin (mg/dl)	18	1.045	0.688	1.518	>0.05
Differential Bilirubin (mg/dl)	18	0.231	0.2419	0.955	>0.05
Blood Urea (mg/dl)	18	0.875	2.219	0.934	>0.05
Serum creatinine (mg/dl)	18	0.056	0.07	0.719	>0.05
Alkaline phosphatase (IU/L)	18	59.565	53.017	1.124	>0.05
Serum uric acid (mg/dl)	18	0.173	0.3234	0.535	>0.05
Serum calcium (mg/dl)	18	0.184	0.1873	0.982	>0.05

df: Degree of freedom, SE: Standard error, HDL: High-density lipoprotein, SGOT: Serum glutamic oxaloacetic transaminase; SGPT: Serum glutamic pyruvic transaminase, RBS: Random blood sugar

with the normal physiology. Immaturity of the newborn's immune system is the reason for a state of "physiological immunodeficiency" that causes increased susceptibility of young children to infections of both viral and bacterial origin.[10] In state of immunodeficiency provided that there is no serious illness associated with it, gold can be of use. The action of gold in the immune system can be justified from the study reports revealing the action of *Swarna Bhasma*-treated mice on specific and nonspecific immune responses in a positive manner[11] and the effect of *Swarna Bhasma* on the peritoneal macrophages by increasing the count and stimulating phagocytic activity,[12] which will be helpful to fight against infections. The statistically significant effect ($P < 0.05$) in decreasing serum IgG value of infants aged 0–1 month showed by the trial drug may be indicative of its impact on immunoglobulin value. However, it may not be named as immunosuppressive effect of the trial drug as the values of IgG were within normal range[13] [Table 15] of that age group. As comparative values with control drug did not show statistically significant difference in IgG values, it can

Table 10: Comparative efficacy of trial and control drugs on biochemical parameters of infants aged 1-12 months

Parameters	df	Mean difference	SE of mean	*t*	*P*
RBS (mg/dl)	46	−3.38	5.65	0.597	>0.05
Serum cholesterol (mg/dl)	46	−5.1	11.95	0.426	>0.05
Serum triglyceride (mg/dl)	46	−15.79	15.01	1.051	>0.05
HDL (mg/dl)	46	−2.65	2.80	0.944	>0.05
SGPT (IU/L)	46	−1.17	3.017	0.388	>0.05
SGOT (IU/L)	46	−6.92	4.760	1.454	>0.05
Total Bilirubin (mg/dl)	46	0.21	0.214	0.980	>0.05
Differential Bilirubin (mg/dl)	46	0.054	0.063	0.840	>0.05
Blood Urea (mg/dl)	46	2.06	1.134	1.816	>0.05
Serum creatinine (mg/dl)	46	0.034	0.033	1.017	>0.05
Alkaline phosphatase (IU/L)	46	−16.69	28.84	0.579	>0.05
Serum uric acid (mg/dl)	46	0.133	0.3951	0.337	>0.05
Serum calcium (mg/dl)	46	0.278	0.21	1.324	>0.05

df: Degree of freedom, SE: Standard error, HDL: High-density lipoprotein, SGOT: Serum glutamic oxaloacetic transaminase; SGPT: Serum glutamic pyruvic transaminase, RBS: Random Blood Sugar

Table 11: Comparative efficacy of trial and control drugs on immunological parameters of infants aged < 1 month

Parameters	df	Mean difference	SE of mean	*t*	*P*
Total protein (g/dl)	18	0.013	0.2728	0.048	>0.05
Albumin (g/dl)	18	0.088	0.082	1.065	>0.05
Globulin (g/dl)	18	0.078	0.2268	0.344	>0.05
AG ratio	18	0.074	0.2769	0.267	>0.05
Serum IgG (mg/dl)	18	−71.86	125.7	0.572	>0.05

df: Degree of freedom, SE: Standard error, IgG: Immunoglobulin G, AG: Albumin-Globulin

be said that trial drug did not act as an immunomodulator in that age group based on the level of significance. The results in infants aged 1–12 months were also not statistically significant.

As the fixed end point for the present study was 'achievement of immune normalization by the infants at the end of the clinical trial' the overall effect of the therapy was assessed with respect to the parameters such as experimental event rate (EER) and control event rate (CER),[14] in which immunomodulation was seen in 32 infants in the trial group, whereas it was observed in 18 infants in the control group. In the present study, achievement of immune normalization by the infants at the end of the treatment referred to either increase or decrease of serum IgG levels within the normal range according to age as compared to the IgG levels before intervention. The changes in serum IgG levels were not fixed to a specific percentage or value due to gross variation observed in the values of the same in infants.

Experimental event rate (EER)[14] and control event rate (CER)[14] are the values useful in determining the therapeutic benefit or risk to the subjects in the experimental group in comparison to those in placebo or conventionally treated control groups and vice versa. *Swarna Prashana* administered in the trial group

Table 12: Comparative efficacy of trial and control drugs on immunological parameters of infants aged 1-12 months

Parameters	df	Mean difference	SE of mean	*t*	*P*
Total protein (g/dl)	46	0.174	0.221	0.785	>0.05
Albumin (g/dl)	46	0.014	0.091	0.153	>0.05
Globulin (g/dl)	46	0.228	0.187	1.215	>0.05
AG ratio	46	0.127	0.1525	0.833	>0.05
Serum IgG (mg/dl)	46	139.35	103.04	1.352	>0.05

df: Degree of freedom, SE: Standard error, IgG: Immunoglobulin G, AG: Albumin-Globulin

Table 13: Effect of trial and control group as immunomodulator at the end of 4 weeks based on immunoglobulin G values

Treatment group	Total number of infants treated	Number of infants who achieved immunomodulation	Number of infants who did not achieved immunomodulation
Trial group	39	32	7
Control group	30	18	12

Table 14: Overall effect of *Swarna Prashana* as an immunomodulator

Parameters tested	Statistical value
EER, event rate with trial group	32/39=0.8205 (82.05%)
CER, event rate with control group	18/30=0.60 (60%)
Experimental event odds	4.57
Control event odds	1.5
OR	3.048
Relative risk (EER/CER)	1.368
Absolute risk increase/decrease (EER-CER)	22.05
Relative risk increase (100[EER−CER]/CER) as a percentage	36.8
Number need to treat (1/[EER−CER])	4.535
χ^2	4.132
P	<0.05
Sensitivity	0.558-0.709 at 95% CI
Specificity	0.416-0.813 at 95% CI

EER: Experimental event rate, CER: Control event rate, CI: Confidence interval, OR: Odds ratio

Table 15: Normal range of immunoglobulin G in infants

Age of infant (In months)	Reference value of IgG (mg/dl)
1	251-906
2	206-601
3	176-581
4	196-558
5	172-814
6	215-704
7-9	217-904
10-12	294-1069

IgG: Immunoglobulin G

of the present study stands as the experimental event, and the control group which received the mixture of *Ghrita* and honey without *Swarna Bhasma* acted as the control event. From the values in the present trial, it can be said that EER was greater than CER which signifies immunomodulatory effect of *Swarna Prashana* in infants.

Odds ratio,[15] in the present study, was 3.048 which is greater than 1, suggesting that the experimental group was better than the control group in normalizing immunoglobulin (IgG) level which in turn is suggestive of immunomodulatory action of *Swarna Prashana* relative risk (RR),[14] which gives the ratio of the probability of an event occurring in the trial group and control group, was 1.368 in the present trial. This indicates that the event of immunomodulation in the group who received *Swarna Prashana* is more likely to happen than in those who did not received the same.

RR increase or difference,[14] which is useful in determining an appropriate treatment plan, i.e., increase in immune normalization happening after *Swarna Prashana* was 36.8% suggesting better immunomodulatory action in trial group. Absolute risk reduction[15] of the present study was 22.05 which represents the immunomodulatory activity of *Swarna Prashana* in the trial group. Number needed to treat (NNT)[16] is an absolute effect measure which is interpreted as the number of patients needed to be treated with one therapy versus another for one patient to encounter an additional outcome of intended interest within a defined period of time. In the present study, NNT was 4.535, suggesting that 1 out of every 4.535 infants who were receiving *Swarna Prashana* had normalization of immunoglobulins.

No adverse drug reaction (ADR) reported during the study as well as follow-up period can be attributed to no acute and chronic toxicity of *Swarna Bhasma* as cited in experimental studies[17,18] and supported by the normal values of LFT and RFT in the present trial.

Probable mode of action of *Swarna Prashana*

Swarna Prashana in the present study can be categorized as the administration of an electuary containing gold formulation (*Swarna Bhasma*) mixed with a lipid – *Ghrita* and a sweetner – honey. The concept of sublingual immunotherapy states that it is effective in optimal doses, preventing new sensitizations and consistent with induction of tolerance.[19] As cited in a study,[20] nanoparticles are

said to be absorbed through sublingual route directly into the bloodstream. Gold nanoparticles show size-dependent absorption through rat skin and intestine,[21] and it was observed that smaller particles (~15 nm) were absorbed more than larger particles (>100 nm).[22] The study also states that colloidal gold uptake in gastrointestinal tract is dependent on the particle size, i.e., smaller particles cross the gastrointestinal tract more readily. Nanoparticles of gold probably present in *Swarna Bhasma* might have been absorbed into the body through both sublingual and intestinal route and reached the target site of action causing catalytic stimulation of the reticulo–endothelial system and general defense mechanisms as cited in an earlier study.[23]

Conclusion

The study revealed no statistical differences between the trial (*Swarna Prashana*) and control groups (honey and *Ghrita*) on the anthropometry, suggesting that the trial drug did not hamper normal growth of the infants. The normalcy of hematological and biochemical parameters suggested the trial drug. *Swarna Prashana* to be safe. The efficacy of *Swarna Prashana* as an immunomodulator was evident from number needed to treat (NNT).

Limitation and suggestion

Small sample size and fewer immunological parameters of assessment were the limitations in the study. Clinical studies in larger population with additional immunological parameters would fetch more evidences.

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Conflicts of interest

There are no conflicts of interest.

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