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Infant mortality in tribal communities of a rural remote region in context of biomass fuel use

Abstract

Background: Infant mortality (IM) rates have fallen in many developing countries, but rates of fall have been low.

Objective: Community based study was carried out to know about IM in context of biomass fuel use by remote rural communities.

Material methods: After approval of institute's ethics committee, study was conducted in 100 villages around the village with health facility, randomly divided into 50 study villages, sub divided into 40 where advocacy to prevent exposure from Biomass fuel was done, 10 in addition to advocacy, Chimneys were fixed on roofs of huts with no windows, biomass fuel used, 50 villages, (40 and 10 control villages), neither advocacy nor Chimneys.

Results: In 40 study villages, 2700 pregnancies, 2431 (90.1%) live births were recorded, 5 (0.21%) infant deaths (ID) occurred, 2 (0.1%) of 1398 male live births, one preterm born had acute respiratory distress (ARD), other had pneumonia, 3 (0.3%) of 1033 female live births, one preterm born who had ARD, 2 septicaemia. Similarly 2700 pregnancies were recorded in 40 control villages and 2259 (83.7%) live births occurred with 11 (0.49%) ID, statistically significant difference (P value <0.0203), 4 (0.3%) of 1278 male live births, one born preterm, later had ARD, other pneumonia, 2 septicaemia, 7 (0.7%) of 981 female babies, statistically significant difference between male, female babies, 2 preterm born later had ARD, one had pneumonia, one diarrhoea dehydration, 2 septicaemia, in one cause was unknown.

Conclusion: For wellbeing of every infant collective actions are needed, reducing biomass fuel effect also.

Keywords: Infant mortality, rural women, biomass fuel

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Background

The infant mortality rates (IMR) are often used as a measure of any country's health because factors influencing population health and infant deaths (ID) are similar.[1] Although IMR have fallen in many developing countries over the past two decades, but the rates of fall have been less than essential. Kamath[2] opined that infant mortality (IM) was the result of a complex web of determinants at different levels and their understanding was essential for preventive modalities at different levels including rural households. Inequalities in relation to IM pose a big challenge for countries trying to move towards the internationally agreed upon targets on child mortality by 2030.[3] There is a lack of high-quality evidence on IM measured through different dimensions of social inequality, use of biomass fuel for cooking and various other household needs is one such issue.

Objective

Community based study was carried out to know about IM in context of use of biomass fuel by rural tribal pregnant women who live in extreme poverty.

Material and methods

Study setting

Total 100 villages near the village with health facility were randomly divided into 50 study and 50 controls and further sub divided into 40 villages where advocacy to prevent effects of Biomass fuel was done and in 10 study villages in addition to Advocacy, Chimneys were also fixed, on the roofs of huts which had no windows and biomass fuel was used for cooking, heating water, protection from cold etc. Fifty villages where neither advocacy was done nor Chimneys were fixed became controls, 40 and 10 control villages for 40 and 10 study villages respectively.

Study type: Prospective cohort study.

Study sample: All live births in the villages were included so no calculation was done. Total 2431 unexposed and 2259 women, exposed to Biomass fuel became study sample.

Study period: Almost two years.

Inclusion criteria - All live births over a year were included

After approval of institute's ethics committee information was collected after taking consent of mother and all live births in 100 villages were followed. Information included demographic features of woman and details of infant deaths with causes. Data was complied using Microsoft excel version 2007. Appropriate statistical tests were applied and p values were calculated, p value <0.5 was taken as statistically significant.

Results

In 40 study villages where advocacy about protection from ill effects of biomass fuel use was done, total 2700 pregnancies and 2431 (90.1%) live births were reported and 5 (0.21%) ID occurred, 2 (0.1%) male babies out of 1398 male live births, one was preterm born baby who later developed acute respiratory distress (ARD) and other had pneumonia and 3(0.3%) female babies died out of 1033 female live births, one was preterm born who developed ARD and

2 had septicaemia. Similarly 2700 pregnancies and 2259 (83.7%) live births with and 11 (0.49%) ID were reported in 40 control villages, statistically significant difference between study and control villages (p value <0.0203). Total 4 (0.3%) ID were out of 1278 male live births, one was due to ARD in a preterm born baby, one due to pneumonia and 2 septicaemia and 7 (0.7%) female babies died out of 981 female babies, statistically significant difference between male and female babies (p value 0.0016), 2 babies died because of ARD in preterm born babies, other had pneumonia, one died of diarrhoea and dehydration, 2 had septicaemia and in one cause was not known. There was statistically significant difference between literate and illiterate mothers in study and control villages (p value 0.0001). There was statistically significant difference between economically low and low middle economic class and upper economic class families (p value 0.0001). There was statistically significant difference between those with one birth and those with many births in study and control villages (p value 0.001) (Tables 1&2).

Table 1 Infant mortality in 40 study villages

Variables	Live births	%	Infant deaths	%	Male live births	%	Male infant deaths		Female live births	%	Female infant deaths	
Age							**No.**	**%**			**No.**	**%**
15 To 19	803	33	2	0.2	463	57.7	1	0.2	340	42.3	1	0.3
20 To 29	1464	60.2	3	0.2	837	57.2	1	0.1	627	42.8	2	0.3
30 To 39	164	6.7	0	0	98	59.7	0	0	66	40.3	0	0
Total	2431	100	5	0.2	1398	58	2	0.1	1033	42.5	3	0.3
Education												
Illiterate	744	30.6	3	0.4	418	56.2	1	0.2	326	43.8	2	0.6
Primary	578	35.3	2	0.3	323	55.9	1	0.3	255	44.1	1	0.4
Middle /highschool	828	34.1	0	0	474	33.9	0	0	354	34.2	0	0
Graduate	168	6.9	0	0	114	67.9	0	0	54	32.1	0	0
Post Graduate	113	4.6	0	0	69	61.1	0	0	44	38.9	0	0
Total	2431	100	5	0.2	1398	58	2	0.1	1033	42.5	3	0.3
Occupation												
Housewife	1064	43.8	4	0.4	624	58.6	2	0.3	440	41.4	2	0.5
Unskilled	809	33.3	1	0.1	459	56.7	0	0	350	43.3	1	0.3
Semi-Skilled	341	14	0	0	189	55.4	0	0	152	44.6	0	0
Skilled	139	5.7	0	0	81	58.3	0	0	58	41.7	0	0
Business	78	3.2	0	0	45	57.7	0	0	33	42.3	0	0
Total	2431	100	5	0.2	1398	58	2	0.1	1033	42.5	3	0.3
Economic Status												
Upper	53	2.2	0	0	29	54.7	0	0	24	45.3	0	0
Middle Upper	208	8.6	0	0	121	58.2	0	0	87	41.8	0	0
Middle	319	13.1	1	0.3	186	58.3	0	0	133	41.7	1	0.8
Middle Lower	763	31.4	2	0.3	441	57.8	1	0.2	322	42.2	1	0.3
Lower	1088	44.8	2	0.2	621	57.1	1	0.2	467	42.9	1	0.2
Total	2431	100	5	0.2	1398	58	2	0.1	1033	42.5	3	0.3
Parity												
P1	993	40.8	2	0.2	574	57.8	2	0.3	419	42.2	0	0
P2-P3	1311	53.9	3	0.2	751	57.3	0	0	560	42.7	3	0.5
P4 Above	127	5.2	0	0	73	57.5	0	0	54	42.5	0	0
Total	2431	100	5	0.2	1398	58	2	0.1	1033	42.5	3	0.3

Citation: Chhabra S, Rathod V. Infant mortality in tribal communities of a rural remote region in context of biomass fuel use. *Pregnancy & Child Birth.* 2023;9(4):126–132. DOI: 10.15406/ipcb.2023.09.00290

Table 2 Infant mortality in 40 control villages

Variables	Live births	%	Infant deaths	%	Male live births	%	Male infant deaths		Female live births	%	Female infant deaths	
Age							**No.**	**%**			**No.**	**%**
15 To 19	687	30.4	4	0.6	383	55.7	2	0.5	304	44.3	2	0.7
20 To 29	1374	59.6	7	0.5	768	55.9	2	0.2	579	44.1	5	0.8
30 To 39	225	9.9	0	0	127	56.4	0	0	98	43.6	0	0
Total	2259	100	11	0.5	1278	56.6	4	0.3	981	43.4	7	0.7
Education												
Illiterate	857	37.9	5	0.6	489	57.1	2	0.4	368	42.9	3	0.8
Primary	613	27.1	3	0.5	342	55.8	1	0.3	271	44.2	2	0.7
Middle/ High	666	29.5	1	0.15	373	56	1	0.2	289	43.4	2	0.3
Graduate	87	3.9	0	0	51	58.6	0	0	36	41.4	0	0
Post Graduate	36	1.6	0	0	19	52.8	0	0	17	47.2	0	0
Total	2259	100	11	0.5	1278	56.6	4	0.3	981	43.4	7	0.7
Occupation												
Homemakers	1033	45.7	6	0.6	589	57	3	0.5	444	43	3	0.7
Unskilled	798	35.3	3	0.4	425	53.3	1	0.2	373	46.7	2	0.5
Semi-Skilled	275	12.2	2	0.7	174	63.3	0	0	101	36.7	2	2
Skilled	98	4.3	0	0	59	60.2	0	0	39	39.8	0	0
Business	55	2.4	0	0	31	56.4	0	0	24	43.6	0	0
Total	2259	100	11	0.5	1278	56.6	4	0.3	981	43.4	7	0.7
Economic Status												
Upper	38	1.7	0	0	22	57.9	0	0	16	42.1	0	0
Middle Upper	157	6.9	0	0	91	58	0	0	66	42	0	0
Middle	278	12.3	3	1.1	152	54.7	1	0.7	126	45.3	2	1.6
Middle Lower	769	34	4	0.5	432	56.2	1	0.2	337	43.8	3	0.9
Lower	1017	45	4	0.4	581	57.1	2	0.3	436	42.9	2	0.5
Total	2259	100	11	0.5	1278	56.6	4	0.3	981	43.4	7	0.7
Parity												
P1	779	34.5	4	0.5	436	56	1	0.2	343	44	3	0.9
P2–P3	1306	57.8	7	0.5	740	56.6	3	0.4	566	43.4	4	0.7
P4 Above	174	7.7	0	0	102	58.6	0	0	72	41.4	0	0
Total	2259	100	11	0.5	1278	56.6	4	0.3	981	43.4	7	0.7

In 40 study villages, 2135 (87.8%) mothers, out of 2431 mothers who had live births, were Biomass fuel users and only 296 (12.2%) of 2431 were non-users of Biomass fuel. This made comparison difficult but attempts were made as the study was to know what was happening due to Biomass fuel use in these villages. There were 5 (0.23%) ID amongst 2135 live births in mothers of Biomass fuel users, 2 (0.2%) of 1308 male babies, one had ARD in a preterm born baby and other had pneumonia and of 3 (0.4%) of 827 female babies, one had ARD in a preterm born baby and 2 had septicaemia, statistically insignificant difference between male and female babies (p value 0.1403). There was no ID in non-users of Biomass fuel. In 10 study villages out of 50 study villages where Chimneys were also installed in addition to advocacy, there were 673 live births and no infant death. Overall 613 live births occurred in 10 control villages, 3 (0.49%) ID occurred, one (0.3%) of 382 male babies died of pneumonia and 2 (0.9%) of 231 female babies, one had ARD in a preterm born baby and one had septicaemia (Tables 3–5).

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Table 3 Infant mortality in biomass fuel users of 40 study villages

Variables	Live births of bio-mass fuel users	%	Infant deaths	%	Male live births	%	Male infant deaths		Female live births	%	Female infant deaths	
Age							**No.**	**%**			**No.**	**%**
15 To 19	690	32.3	2	0.3	423	61.3	1	0.2	267	39	1	0.4
20 To 29	1286	60.2	3	0.1	788	61.3	1	0.1	498	39	2	0.4
30 To 39	159	7.4	0	0	97	61	0	0	62	39	0	0
Total	2135	100	5	0.2	1308	61.3	2	0.2	827	39	3	0
Education												
Illiterate	715	33.5	3	0.4	439	61.4	1	0.2	276	39	2	0.7
Primary	536	25.1	2	0.4	334	62.3	1	0.3	202	38	1	0.5
Middle/Highschool	675	31.6	0	0	481	71.3	0	0	268	39.7	0	0
Graduate	120	5.6	0	0	74	61.7	0	0	46	38.3	0	0
Post Graduate	89	4.2	0	0	54	60.7	0	0	35	39	0	0
Total	2135	100	5	0.2	1308	61.3	2	0.2	827	39	3	0
Occupation												
Housewife	999	46.8	4	0.4	617	61.8	2	0.3	382	38	2	0.5
Unskilled	728	34.1	1	0.1	444	61	0	0	284	39	1	0.4
Semi-Skilled	252	11.8	0	0	154	61.1	0	0	98	39	0	0
Skilled	101	4.7	0	0	61	60.4	0	0	40	40	0	0
Business	55	2.6	0	0	32	58.2	0	0	23	42	0	0
Total	2135	100	5	0.2	1308	61.3	2	0.2	827	39	3	0
Economic Status												
Upper	20	0.9	0	0	13	65	0	0	7	35	0	0
Middle Upper	119	5.6	0	0	74	62.2	0	0	45	38	0	0
Middle	248	11.6	1	0.4	149	60.1	0	0	99	40	1	1
Middle Lower	709	33.2	2	0.3	448	63.2	1	0.2	261	37	1	0.4
Lower	1039	48.7	2	0.2	624	60.1	1	0.2	415	40	1	0.2
Total	2135	100	5	0.2	1308	61.3	2	0.2	827	39	3	0
Parity												
P1	909	42.6	2	0.2	557	61.3	2	0.4	352	39	0	0
P2-P3	1099	51.5	3	0.3	670	61	0	0	429	39	3	0.7
P5 Above	127	5.9	0	0	81	63.8	0	0	46	36	0	0
Total	2135	100	5	0.2	1308	61.3	2	0.2	827	39	3	0

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Table 4 Infant mortality in 10 control villages

Variables	Live births	%	Infant deaths	%	Male live births	%	Male infant deaths		Female live births	%	Female infant deaths	
Age							**No.**	**%**			**No.**	**%**
15 To 19	217	35	2	0.9	139	64.1	1	0.7	78	35.9	1	1.3
20 To 29	338	55	1	0.3	209	61.8	0	0	129	38.2	1	0.7
30 To 39	58	9.5	0	0	34	58.6	0	0	24	41.4	0	0
Total	613	100	3	0.5	382	62.3	1	0.3	231	38	2	0.9
Education												
Illiterate	203	33	2	1	126	62.1	1	0.8	77	37.9	1	1.3
Primary	241	39	1	0.4	151	62.7	0	0	90	37.3	1	1.1
Middl/High	138	22.5	0	0	87	63.0	0	0	51	37.0	0	0
Graduate	19	3.1	0	0	11	57.9	0	0	8	42.1	0	0
Post Graduate	12	2	0	0	7	58.3	0	0	5	41.7	0	0
Total	613	100	3	0.5	382	62.3	1	0.3	231	38	2	0.9
Occupation												
Housewife	267	44	3	1.1	169	63.3	1	0.6	98	36.7	2	2
Unskilled	197	32	0	0	125	63.5	0	0	72	36.5	0	0
Semi-Skilled	87	14	0	0	52	59.8	0	0	35	40.2	0	0
Skilled	47	7.7	0	0	28	59.6	0	0	19	40.4	0	0
Business	15	2.4	0	0	8	53.3	0	0	7	46.7	0	0
Total	613	100	3	0.5	382	62.3	1	0.3	231	38	2	0.9
Economic Status												
Upper	12	2	0	0	7	58.3	0	0	5	41.7	0	0
Upper Middle	27	4.4	0	0	17	63	0	0	10	37	0	0
Upper Lower	119	19	0	0	74	62.2	0	0	45	37.8	0	0
Lower Middle	179	29	1	0.6	115	64.2	0	0	64	35.8	1	1.6
Lower	276	45	2	0.7	169	61.2	1	0.6	107	38.8	1	0.9
Total	613	100	3	0.5	382	62.3	1	0.3	231	38	2	0.9
Parity												
P1	196	32	1	0.5	128	65.3	1	0.8	68	34.7	0	0
P2	384	63	2	0.5	235	61.2	0	0	149	38.8	2	1.3
P4 Above	33	5.4	0	0	19	57.6	0	0	14	42.4	0	0
Total	613	100	3	0.5	382	62.3	1	0.3	231	38	2	0.9

* No Infant mortality in 10 study villages biomass fuel users and non-users.

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Table 5 Causes of infant mortality

Sr.No	Causes of infant mortality	Total cases	%	Sr.No	Causes of infant mortality	Total cases	%
40 Study villages				**40 control villages**			
1	Total Live Births	2431	100.0	1	Total Live Births	2259	100.0
2	Respiratory Distress	2	0.1	2	Respiratory Distress Syndrome	3	0.1
3	Septicaemia	2	0.1	3	Septicaemia	4	0.2
4	Pneumonia	1	0.0	4	Pneumonia	2	0.1
5	Diarrhoea and dehydration	0	0.0	5	Diarrhoea and dehydration	1	0.0
6	Not Known	0	0.0	6	Not Known	1	0.0
40 Biomass Fuel Users				40 Non-User of Biomass Fuel			
1	Total Live Births	2135	100.0	1	Total Live Births	565	100.0
2	Respiratory Distress	2	0.1	2	Respiratory Distress Syndrome	0	0.0
3	Septicaemia	2	0.1	3	Septicaemia	0	0.0
4	Pneumonia	1	0.0	4	Pneumonia	0	0.0
5	Diarrhoea and dehydration	0	0.0	5	Diarrhoea and dehydration	0	0.0
6	Not Known	0	0.0	6	Not Known	0	0.0
10 Study Villages				10 Control Villages			
1	Total Live Births	673	100.0	1	Total Live Births	613	100.0
2	Respiratory Distress	0	0.0	2	Respiratory Distress Syndrome	1	0.2
3	Septicaemia	0	0.0	3	Septicaemia	1	0.2
4	Pneumonia	0	0.0	4	Pneumonia	1	0.2
5	Diarrhoea and dehydration	0	0.0	5	Diarrhoea and dehydration	0	0.0
6	Not Known	0	0.0	6	Not Known	0	0.0

Discussion

IMR is regarded as an important and sensitive indicator of the health status of a community. IMRs vary from country to country and state to state across the world, because efforts and their consistency, the living standard of the communities and the effectiveness of interventions for improving mothers and babies health, vary. Kamath [2] opined that fast IMR decline has been observed in India in recent years, drop by an average rate of 4.56% per year in last some years. However, with the pace, the country will miss the target to achieve the fourth Millennium Development Goal (MDG-4), in which the aim was to reduce under-five mortality rate and IMR by two-thirds between 1990 and 2015 but, almost all countries of the South East Asia Region have lower IMR than India. Researchers have reported that though India and China had almost the same IMR some sixty years ago, the IMR in China is one-fourth of India's IMR. China has reduced its IMR by 75% compared to that of 1990, while India could reduce it only by 53%. Shah[4] reported that IMR during their study period was 46.5/1000 live births in rural Uttar Pradesh of India, and the main causes of ID were birth asphyxia, diarrhoea, pneumonia, preterm births with small for date. A high proportion of preventable and high IM still exists in an area which was under continuous health and demographic surveillance. It is suggested that home-based preventive care needed to be enhanced to enable the mothers to identify and respond to the danger signs in babies. It has been opined that verbal autopsy and social autopsy need to be always done to guide policy interventions aimed at reduction of IM.[5] Rinne[6] reported that around one half of the world's population relied on Biomass fuel like Wood, Charcoal, Crop Residues, or Cow dung as a primary source of domestic energy. This practice resulted in wide spread exposure to indoor air pollution (IAP), predominantly in developing countries where other sources of energy are becoming increasingly inaccessible and unaffordable. Tielsch et al.,[7] reported that the exposure to IAP due to open burning of biomass fuel was common in low- and middle-income countries. Previous studies linked this exposure to an increased risk of respiratory illnesses, low birth weight (LBW) and other disorders. Researchers assessed the association between exposure to biomass fuel sources and second-hand tobacco smoke (SHTS) at home and adverse health outcomes in early infancy in a population in rural South India and found that exposed infants also had 45% and 30% increased risks of underweight and stunting at 6 months respectively. Shah[4] opined that multiple factors including social and economic conditions, health care and environment significantly played a role in IM and childhood mortality reduction in both are global priorities. In the present study, overall there were 19 (0.31%) ID amongst 5976 live births with IMR of 3.1 deaths per 1000 live births. In study villages, of 2431 (90.1%) live births, 5 (0.21%) ID occurred, 2 (0.1%) male babies out of 1398 male live births, 3(0.3%) female babies out of 1033 female live births.

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Similarly 2259 (83.7%) live births occurred in 40 control villages with 11 (0.49%) ID, 4 (0.3%) out of 1278 male live births, 7 (0.7%) female babies died out of 981 female babies. Sahu[8] did a study to examine levels, trends and socio demographic factors associated with IM in rural areas from India and reported that findings supported the need to focus on age of women at first birth and spacing between two births. In the present study, overall 0.4% ID were reported by adolescent, mothers and 0.2% by adult mothers, though double in adolescents, but statistically insignificant difference in adolescents and adults in study and control villages (p value 0.2425). Total 0.25% ID occurred in teenagers in study villages, 0.2% of all male live births and 0.3% of female babies. And in controls 0.58% ID occurred in teenagers, 0.5% male and 0.7% female babies. Weldearegawi[9] did a study about risk factors in IM to identify causes of deaths in a rural population of Northern Ethiopia. Findings suggested the need to improve the new-born care, and empower teenagers to delay pregnancy and attain higher levels of education. The influence of women's literacy on IM was explained by better health care at birth, and preventive and curative health care during the post-neo-natal period. In the present study 0.5% ID were reported in illiterate mothers and 0.3% educated mothers and 0.4% ID were reported by housewives and 0.3% ID in economically low class women and no ID occurred in upper class. There were differences in ID with education, occupation and economic status. Shibre[3] did a study and reported notable disadvantages for children born to poor and uneducated women who lived in rural areas and those residing in certain regions of the country. In the present study 0.1% ID occurred in male babies and 0.3% amongst female babies. Female infants had a higher risk of death compared to male infants in tribal rural communities. Policymakers and planners needed to address the disproportionately higher clustering of ID among infants born to disadvantaged subpopulations through interventions that benefit such subgroups. The IAP has become a major concern because women and babies are highly exposed to various types of smoke, more so unclean fuels used for cooking and heating in the households which result into risk of respiratory disorders among them. Living in households using biomass and solid fuels have a significantly higher risk of acute respiratory infection (ARI) than those living in households using cleaner fuels. Decreasing household biomass and solid fuel use and increasing use of improved stove technology impacts the health effects of IAP. Biomass fuel used for cooking results in widespread exposure to IAP, affecting nearly 3 billion people throughout the world.[11] Rinne[6] did a study to explore the relationship between biomass fuel, IM, and babies respiratory symptoms and reported a significant trend for higher IM among households that used a greater proportion of biomass fuel. Household air pollution (HAP) mainly from cooking fuel was one of the major causes of respiratory illnesses and deaths among young children in Pakistan. Strong association between use of cooking fuel and mortality was evident in under five for households without a separate kitchen and use of polluting fuels.[12] Open burning of biomass fuel in the home was associated with significant health risks to the new-borns and young infants. It is suggested to do more community-based studies to clarify causal connections and identify effective approaches to reduce the burden of illnesses. Wichmann[13] did a study to know the association between the combustion of wood, animal dung, coal and paraffin (polluting fuels) for cooking and heating in under five in South Africa and reported that exposure to smoke of cooking and heating polluting fuels was significantly associated with under five mortality, after controlling for mother's age at birth, water source, asset index and household crowdedness. For health and wellbeing of every infant, collective actions are needed.

Conclusion

Most of the deaths among infants occurred due to respiratory problems more in female babies and those using biofuel mass, without preventive measures. Prevention of usage of biomass fuel by rural tribal communities is essential and more research is needed.

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Conflicts of interest

There is no conflict of interest.

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