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Epidemiological Investigation of Hepato-Pulmonary Bovine Hydatidosis and Its Economic and Zoonotic Importance at Jimma Municipal Abattoir, Ethiopia

Atsede Brhane Belay Abebe*
School of Veterinary Medicine, Jimmma University, P.O.Box:307 Jimma, Ethiopia

Abstract
A cross-sectional study was conducted from November 2013 – March 2014 at Jimma municipal abattoir with the aim of investigating the prevalence, fertility and viability of the hydatid cyst and economic losses due to liver and lung condemnation and to access the knowledge of the community about bovine hydatidosis. Out of the total 384 examined cattle 118 (30.7%) cattle were found harboring one or more hydatid cyst in their lung and liver. From examined animals 113(29.4%), 36(9.4%) and 32 (8.3%) contained hydatid cyst in their lung, liver and in both lung and liver, respectively. Lung was the most predominantly affected organ followed by the liver. From 710 cysts collected from lung 120 (16.9%), 546(76.9%), 44(6.1%) were found to be small, medium and large respectively. Out of 197 cysts collected from liver 121(61.7%) were small size and 75(38.3%) was found to be medium sized. Higher number of large and medium size cyst were found in lung and small cysts were predominant in liver. From the 78 cysts only 28(35.8%) cyst of lung were found to be fertile and 50(64.2%) of them were infertile (sterile) and 19(24.5%) of them were found to be viable. Age had a significant effect on the occurrence of bovine hydatidosis and high prevalence was recorded in older animals. However, sex and breed didn't show any difference of statistical significance (P>0.05). In the current study, only (20.65%) of the participants had an awareness of *echinococcosis* or hydatidosis and only 18.5% of the respondents knew as the disease was zonotic disease and the rest 81.5% of participants do not know whether the disease is zoonotic or not. In this questioner survey, level of awareness was significantly different among age groups of the respondents and adult respondents had more awareness than the rest (p=0.04). The annual financial losses from organ condemnation due to hepato-pulmonary bovine hydatidosis at Jimma municipal abattoir were estimated to be 94485.60 ETB or 4972.93USD. The present study showed that hepato- pulmonary bovine hydatidosis is prevalent in Jimma area. Factors like presence of more stray dogs that visits the abattoir ground and fed on condemned organs, low public awareness about hydatidosis and backyard slaughtering favors the disease transmission in this area. Public health measures such as control of stray dogs and strengthening of meat inspection services at abattoirs should be practiced.
Keywords: Liver, Lung, prevalence, hydatid cyst, economic loss, zoonoses, Municipal abattoir, Jimma

1. INTRODUCTION

Hydatidosis is a term used to describe infection of animals and humans with adult *echinococcusis* tape worm /larva metacestode stage of *echinococcus* species (Grant and Mcmanus, 2003; Perija, 2004). Cystic *echinococcosis* or hydatidosis, caused by the metacestode of *Echinococcus granulosus*, is one of the most common zoonotic diseases associated with huge economic losses and great public health significance worldwide (Romig *et al.,* 2006).

Four species of *Echinococcus* (*E*) are currently considered taxonomically valid: *E. granulosus, E. multilocularis*, *E. oligarthrus*and *E. vogeli* (Eckert *et al.,* 2002). The cestode *E. granulosus* is the causative agent of cystic hydatid disease, or hydatidosis, which is recognized as one of the major zoonoses, affecting both humans and domestic animals in various parts of the world (Gottstein and Hemphill, 1997).

This cyclozoonosis requires two vertebrate hosts to uphold the life cycle (Eckert and Deplazes, 2004). The eggs are ingested by an intermediate host, in which the metacestode stage and protoscolices develop. The cycle is completed if such an intermediate host is eaten by a suitable carnivore (Eckert *et al.,* 2002).Dog and other carnivores that harbor the adult cestode in their small intestine are the definitive hosts for the parasite, while a wide range of mammalian species including domestic ungulates and man act as intermediate hosts (Kumsa,1994). Humans become infected by ingestion of egg passed in the feces of dogs (Budke *et al*., 2006).

A number of studies have shown that hydatidosis is a disease of increasingly public health and socio-economic concern. The disease is currently considered an emerging or re-emerging disease and the geographic distribution and extent are greater than previously believed (Thompson and McManus, 2002; Torgerson and Budke, 2003; Dakkak, 2010). The disease is one of the neglected diseases worlds over. Hydatidosis is still endemic in sheep herding areas of the world and is inflicting public health problems in the Mediterranean, Middle East, Asia, South America and Africa, including Ethiopia (Kevin *et al*., 1991, Shambesh *et al*., 1999, Magambo *et al*., 2006).

Even though hydatidosis has been known and documented in Ethiopia as early as 1970, it is still the

major cause of organ condemnation in most Ethiopian abattoirs and lead to huge economic losses to the livestock industry (Hagos, 1997). In Ethiopia prevalence rate changing between 13.7 to 72.44% in cattle and 9.9 to 35% in sheep was described (Jobre *et al*., 1996; Kebebe *et al*., 2009).

The most important intermediate host is sheep, which appears to be the natural intermediate host. Scolices from these animals are the most highly infective for dogs (Kumsa, 1994). Consumption of offal containing viable hydatid cysts results in infection of definitive host carnivores including dogs that void eggs with their feces to contaminate the environment. The adult tapeworm in the definitive host is harmless unlike the hydatid cyst in the intermediate host animals that is responsible for immense economic and medical importance in infected hosts (Azlaf and Dakkak, 2006; Battelli, 2009; Ibrahim, 2010). Food animals such as sheep, goats, cattle, camels, buffaloes, and pigs acquire the infection by ingestion of infective eggs with contaminated grass and water. Man is infected incidentally up on ingestion of infective eggs in contaminated water, vegetables, or other food or through direct contact with the dog. Upon ingestion, the oncospheres penetrate the intestinal wall and reach visceral organs such as the liver, lungs, heart, and kidneys of animals and humans to develop to hydatid cysts (Fakhar and Sadjjadi, 2007).

The most common production practices that increase the prevalence and the risk of exposure of domestic animals to cystic echinococcosis (hydatidosis) are traditional systems of raising animals (extensive or semi-extensive grazing), widespread backyard slaughtering of animals, absence of rigorous meat inspection procedures, improper disposal of dead animals, keeping of high number of dogs, failure to treat dogs with anthelmintics, habit of feeding dogs with condemned offal and the subsequent contamination of pasture and grazing fields, and grazing of animals in communal fields where stray dogs have free access (Garippa *et al.,* 2004; Ibrahim, 2010; Romig *et al.,* 2006).This can facilitate the maintenances of the life cycle of *E. granulosus* which is the causative agent of cystic hydatidosis and consequently the high rate of infection of susceptible hosts (Jobre *et al.,* 1996).

Previous studies on the prevalence of Bovine hydatidosis in the abattoir rarely consider the epidemiology, public health and economic importance of hydatidosis in the study area.

Objectives of the study are:

- To determine the prevalence of hydatidosis and associated risk factors in cattle slaughtered at Jimma municipal abattoir,
- To calculate the economic losses associated with the parasite,
- To assess the fertility and viability of hydatid cysts and
- To assess the knowledge of community about hydatidosis.

3. MATERIALS AND METHODS

3. 1 Study Area:

This study was conducted from November 2013 to March 2014 in Jimma municipal abattoir. Jimma town, the capital of Jimma zone is located in Oromia Regional Administration at 352km south west of Addis Ababa at altitude of 7°41' N and longitude of 36°50' E. The area received a mean annual rain fall of about 1530mm which comes from long and short rainy seasons. The average minimum and maximum annual temperatures were 7°C and 30°C, respectively (JAO, 2008). The average minimum and maximum annual temperature ranges between 14.4 and 26.7°C, respectively. According to CSA (2009), Jimma town has a total population of 120,600.

3.2 Study Population

The study animals comprise was cattle slaughtered at Jimma municipal abattoir. Those include different age groups, breeds, and both sex of cattle which were brought to Jimma municipal abattoir from different districts of Jimma zone.

3.3. Study Design

A cross sectional abattoir survey was conducted from November 2013 – March 2014 to determine the prevalence of hepato-pulmonary bovine hydatidosis from 384 cattle slaughtered in the abattoir using random sampling techniques and semi structured questionnaires were prepared to access the knowledge of the community. Both ante mortem and postmortem inspection procedures was carried out during the study periods.

3.4. Sample Size

Since there was no study conducted on hepato-pulmonary bovine hydatidosis previously, the prevalence was expected to be 50% according to Thrusfield (2005).

$$n = \frac{1.96^2 Pexp\,(1 - Pexp)}{d^2}$$

Where: n = required sample size; Pexp = expected prevalence (50%); d = desired absolute precision for a 95% confidence interval. Accordingly 384 cattle were recruited for sample collection during the study periods.

3.5. Data Collection

Regular visits (3 days per week) were made to conduct ante and post mortem examination of slaughtered cattle. During ante mortem examination, each study animal was given an identification number and age, breed, origin and sex of animals were recorded. Estimation of age was carried out by examination of teeth eruption using the approach forwarded by De Lahunta and Habel (1986). During meat inspection, carcasses and their respective organs (liver and lungs) were carefully examined in accordance to the procedures of the Ethiopian Ministry of Agriculture Meat Inspection Regulation (1972) for the detection of hydatidosis. Visual inspection and palpation, followed by multiple incisions in the liver and lungs was made to detect the presence of hydatid cysts. Cysts were carefully removed from organs and transported to the Parasitology laboratory of the School of Veterinary Medicine, Jimma University, for further examination. All infected organs (liver and lung) condemned due to hydatidosis were registered.

3.6 Assessment of Economic Losses

The loss due to hydatidosis was estimated by direct organ condemnations.

Direct Organ Condemnation: Lung and livers were condemned due to hydatidosis. Annual cost of the condemned organs due to hydatidosis was assessed using the following formula set by Ogunirad (1980).

ACLLC=CCR X PL1C X L1C+ CCR X PL2C X L2C

Where,

ACLLC=Annual cost of liver and lung condemned.

CCR= average number of cattle slaughtered per annual at Jimma municipal abattoir.

PL1C= percentage of liver condemned

L1C=mean cost of one liver

PL2C= percentage of lung condemned

L2C= mean cost of one lung

3.7 Examination of cysts

The founded hepato-pulmonary cysts were grossly evaluated for degeneration and calcification; there after according to the size and form of cysts, 20 % of cysts were randomly selected for fertility study. The surface of each cyst was sterilized with alcoholic iodine solution then the cyst wall was penetrated using a large size needle. The content was transferred into a sterile container and was examined by light microscope (40x) for the presence of protoscolices. The cysts which contained no protoscolex were considered as unfertile cysts. The viability of the protoscolices was assessed by motility of flame cells as well as ease of staining with 0.1% aqueous eosin solution and examination under a light microscope (Daryani *et al.,* 2007) live protoscolices did not take the dye whereas, the dead ones take the dye.

3.8 Assessment of Public Health Significance of Hydatidosis in Jimma Town

Semi-structured questioner was prepared and randomly selected peoples were administering the questioner.

3.9 Statistical Analysis

Data collected from ante mortem, post mortem and laboratory findings were loaded on Microsoft excel spread sheet and the prevalence of hydatid cyst was calculated by dividing the number of hydatid positive animals with the total number of animals examined. To estimate the effect of risk factors associated with the occurrence of the disease on cattle slaughtered in Jimma municipal abattoir during the study period odds ratio (OR) was calculated for each independent variables using univariate logistic regression analysis on STATA12 statistical soft ware. P value< 0.05 was considered as statistically significant.

4. RESULTS

4.1. Prevalence estimation of hepato_pulmonaryhydatidosis

In the current study a total of 384 heads of cattle with different sex, age group and different origins of animals were examined for the presence of hydatidosis in their liver and lung. Out of the total examined cattle 118 (30.7%) cattle were found harbor one or more hydatid cyst in their lung and liver. During this study lung (29.4%) was found to be the most predominantly affected organ compared to liver (9.4%). The total prevalence of hepato-pulmonary bovine hydatidosis in this study was found to be 30.7% with 0.26 and 0.35lower and upper confidence interval respectively as depicted in (Table 1).

Table 1: Hepato_ pulmonary distribution of hydatid cysts and total prevalence

Organs	**Total no of examined**	**No of infected**	**Prevalence (%)**	**95% Lower CI**	**95% Upper CI**
Lung	384	113	29.4	0.25	0.35
Liver	384	36	9.4	0.23	0.37
Liver and lung	384	32	8.3	0.057	0.115
Total	384	118	30.7	0.26	0.35

Where; CI: Confidence interval

Table 2: Proportion of bovine hydatidosis based on their origin

Variable	Animals examined	No of positive animals	No of negative animals	Proportion (%)
Districts				
Agaro	32	8	24	25
Ambuye	32	10	22	31
Blida	35	10	25	28
Borea	6	2	4	33
Bulbule	30	6	24	20
Chida	4	2	2	50
Dedo	89	29	60	32
Dima	1	1	0	100
Jimma town	2	1	1	50
Kulo	1	0	1	0
Seka	81	23	58	28
Serbo	61	23	38	37.7
Shebea	8	3	5	37

Table 3: Prevalence of hepato_pulmonary hydatidososis in each category of each variable using univariate logistic regression analysis

Variables	No. exam.	No.Ve+	OR	p-value	95%CI	Prev (%)	95%CI
Age(years)							
5	18		Ref*	-	-	22	0.06-0.47
6	108		0.27	0.013	0.095-0.75	29	0.21-0.39
7	120		0.25	0.008	0.090-0.70	28	0.20-0.37
8	88		0.23	0.006	0.078-0.65	26	0.17-0.36
9	45		0.35	0.069	0.114-1.1	35	0.21-0.51
10	5		0.42	0.407	0.056-3.2	40	0.05-0.85
Sex							
Male	382	117	0.44	0.56	0.27-7.11	30.6	0.26 - 0.35
Female	2	1	Ref*	-	-	50	0.01 - 0.98
Breed							
Local	381	117	0.88	0.92	0.07-9.87	30.7	0.26 - 0.35
Exotic	3	1	Ref*	-	-	33	0.008 - 0.90

Where; Ref*= Reference, OR= Odds Ratio, CI= Confidence Interval

4.2. Cyst count and size determination

From the totally examined cattle 113(29.4%) and 36(9.4%) cattle have hydatid cyst in their lungs and liver respectively. 710 cysts were collected from lung and 197 cyst from liver. Totally 906 cyst were collected from both lung and liver. Higher number of large and medium size cyst were found in lung and small cysts were predominant in liver.

Table 4: Distribution of hydatid cyst in liver and lung with respect to size of the cyst

Organ	No (%) of small size	No(%) of medium size	No (%) large size	Total cyst (%)
Lung	120(16.9%)	546(76.9%)	44(6.1%)	710
Liver	121(61.7%)	75(38.3%)	-	196

4.3. Fertility of hydatid cyst

From the totally examined animals (78) or 20% of the animal were randomly selected and examined for fertility and viability test of hydatid cyst. Cysts were collected from the abattoir and examined for fertility test. From the 78 cysts only 28(35.8%) cyst of lung were found to be fertile and 50(64.2%) of them were infertile (sterile). The fertile cysts were subjected for viability test and 19(24.5%) of them were found to be viable.

4.4. Direct economic loss assessment

In this study direct economic loss was assessed and were estimated by counting the condemned lungs and livers due to presence of hydatid cysts and multiplying by price of the lung and liver.113 lungs and 36 livers were condemned due to presence of hydatide cysts. The current average market price of one kg of lung and liver in Jimma town was 15 and 80 ETB respectively. So direct economic loss due to organ condemnation was calculated using the following formula:

ACLLC=CCR X PL1C X L1C+ CCR X PL2C X L2C

ACLLC=7920 x 9.4% x 80 +7920 x 29.4% x15 = 94485.60ETB or 4972.93USD

Generally Jimma municipal abattoirs lost a total of 94485.60 ETB annually due to hepato-pulmonary bovine hydatidosis.

4.5. Assessment of the level of knowledge of people towards hydatidosis in Jimma town

Semi- structured questioners were prepared to accesses the knowledge of the community in Jimma town and 92 randomly selected individuals from the community were interviewed to assess their level of knowledge about hydatidosis. From those 69 of them were males and 23 female with different age, religion, sex and education status.

Table 5: Simple questionnaire about hydatidosis and their response

Question	**Yes**	**No**	**Don't know**
Have you ever heard about hydatidosis	23 (25%)	69 (75%)	-
Have you awared about hydatidosis before	19(20.65%)	73(79.35%)	-
Is hydatidosis is zoonotic	17(18.5%)	-	75(81.5%)
Do you know the sources of infection to human	14(15.2%)	78(84.8%)	
If yes list them	9(9.8%) know source of infection		
Do you have dog	36(39.1%)	56(60.9%)	
Do you have close contact with dog	14(38.9%)	22(61.1%)	
Do you wash your hand after contact with dog	12(33.3%)	24(66.7%)	
Do you have separate house for your dog	15(41.7%)	21(58.3%)	
Do you feed your dog raw liver and lung	23(63.9%)	13(36.1%)	
Do you deworm your dog regularly	14(38.9%)	22(61.1%)	
Do you have habit of consuming raw vegetables and fruit	71(77.1%)	21(22.9%)	
Do you wash it properly before you consuming	67(72.8%)	25(27.2%)	
Do you know the transmission method of hydatidosis from animal to human	17(18.4%)	75(81.6%)	
If yes mention them	6(6.5%) Of them mentioned correctively		
Do you know the prevention and control method of hydatidosis	14(15.2%)	78(84.8%)	
If yes list them	7(7.6%) Of them list the exact method		

Only 25% of the respondents indicated that they have heard about the disease and 20.65% of the respondents have awareness on the knowledge of hydatidosis. In this study hydatidosis was known only by 18.5%

of the interviewed respondents knew as a zoonotic disease but the rest had no information whether it can be transmitted to humans or not and 9.8% of them gave their correct answer on the sources of infection (Table 5). Among 92 respondent 36(39%) of them owned dog. From the respondents who owned dog 23(25%) of them deliberately feed raw liver and lung to their dogs.

5. DISCUSSION

The total prevalence of hepato-pulmonary bovine hydatid cyst in this study was 30.7% .When compared with other reports this study is higher than 16% prevalence of bovine hydatidosis reported at WolaytaSodo municipality abattoir (Nigatu *et al.,* 2009), 15.2% in BirreSheleko and Dangila municipality abattoir (Kebede *et al.,* 2006), (Kebede *et al*., 2011), (15.2%) at Birre-Sheleko and Dangila abattoir, (Jemere and Berhanu, 2011), (16.85%) at WolayitaSodo municipal abattoir.

The prevalence in this study was lower than the studies carried out by Gebretsadik, 2010,(32.1%) in Tigray Region of Ethiopia, Ernest *et al.,*2009 (48.7%) in Ngorongoro District of Arusha region, Tanzania, Getaw *et al.,* 2010,(46.8%) at Hawassa Municipal abattoir , Fromsa and Jobre., 2011(72%) at Assela and Terefe *et al*.,2012, (40.5%) at Addis Ababa abattoirs enterprise. This variation in prevalence of hydatidosis could be due to age difference, different origin and lack of proper disposal of infected carcass, differences in animal husbandry system and the presence stray dog and their relations retarded growth; reduce meat and milk production as well with animals.

Age had a significant effect on the occurrence of bovine hydatidosis. This means when animal become older their susceptibility to the disease was higher than those of young and adults. From the examined cattle age 10 were 0.424 times highly infected than age 5. Age 5 was used as reference. And age 6, 7, 8, and 9 were 0.267, 0.251, 0.225 and 0.351 times highly infected than age group of 5 years. This was in agreement with the findings of Azlaff and Dakkak, (2006) and Regassa *et al*. (2010). This could be mainly due to the fact that aged animals have longer exposure time to eggs of *E. granulosus* in addition to weaker immunity to combat against the infection (Himonas, 1987). However, sex and breed didn't show any difference of statistical significance ($P > 0.05$).

In the current study lung (29.4%) was the most predominantly affected organ than liver (9.4%). In other words lung was 20 times more greatly affected than liver. This might be due to the presence of greater capillary beds in the lung than liver. Higher number of large and medium sized cyst was found in lung, this was due to softer consistency of the lung that allows the development of the cyst, and small cyst was higher in liver due to higher reticulo-endothelial and abundant connective tissue reaction of the organ. The higher proportion of small cysts may indicate late infection of the animals and due to immunological response of the host which might preclude expansion of cyst size (Torgerson *et al*., 2002).

The fertility rate was higher among the cysts of lung. Since lung has relatively softer constancy which allows easier development of the pressure cysts and fertility of hydatid cyst may show a tendency to increase in advanced age of host. This may be related with reduced immunological compatibility of the hosts at their old age of infections (Getaw *et al.,* 2010; Ibrahim, 2010).

In this study the annual economic loss due to hepato-pulmonary bovine hydatidosis at Jimma municipal abattoir from direct loss was estimated to be 94485.60ETB or 4972.93USD. This finding was lower than the report of Endrias *et al.,* 2008, who reported annual economic loss of 160,032.23 ETB at Ambo municipality abattoir and Kebede *et al*., 2008, reported that annual financial loss from organ condemnation and carcass weight loss due to bovine hydatidosis at Birre-Sheleko and Dangila abattoirs were estimated to be $18911.6. And higher than the report of Debas and Ibrahim, 2012, who reported that annual financial loss from organ condemnation due to bovine hydatidosis at Gondar Elfora abattoir were estimated to be 41011.0781 ETB annually. The difference in economic loss analysis in various abattoirs or regions may be due to the variations in the prevalence of the disease, mean annual number of cattle slaughtered in different abattoirs and variations in the retail market price of organs (Polydorous, 1981).

In the current study, only (20.65%) of the participants had an awareness of echinococcosis. This disagrees with the work of (Tesfaye *et al.,* 2012) who reported that only 4% and (Tigre, 2012) 32.2% of the study participants had an awareness of echinococcosis. Similar works were reported by (Kuma *et al*., 2012) only17.3% of the study participants had an awareness of *echinococcosis.*

In this questioner survey, level of awareness was significantly different among age groups of the respondents and adult respondents had more awareness than the rest at ($p=0.04$) or ($P<0.05$). In addition to this there were significant difference between educational status and religion. From the total respondents only 18.5% of the respondents knew as disease was zonotic disease and the rest 81.5% of participants do not know whether the disease was zoonotic or not. This work disagrees with kuma *et al. (*2012) reports that only (11.9%) respondents knew that it's zoonotic. The awareness level of participants in this study was higher than the reported by Kebede *et al.* (2010) and Zelalem, (2012) who indicated an awareness level of 0 and 8% of the households had awareness about zoonotic *echinococcosis,* respectively. The lower level of awareness about

echinococcosis could also be due to the longer incubation period of the disease in humans, in which it takes up to 30 years to manifest clinical signs (CFSPH, 2011).

In this study 39.1% of the participants owned dog(s) and 14(38.9%) respondents have close contact with dogs and (66.5%) of them did not wash their hands after contact with dog and (33.5%) of them have separate house for their dog. Among the dog owners (63.9%) of them reported that they feed their dog raw liver and lung. Feeding the viscera of infected slaughter animals to dogs was reported to facilitate the transmission of the sheep strain of *Echinococcus granulosus* and this was suggested to consequently increase the risk that humans will become infected (Moro and Schantz, 2009). From the dog owners only (39%) of them regularly treat their dog with ant- helminthics. This disagreed with Tigre, 2012 and kuma *et al*., 2012 reported that only 4.3% and 4.6% of the dog owners treat their dogs with anthelminthic drugs periodically around Jimma area respectively. 78% of the respondents have habit of consuming raw or uncooked vegetables and fruits.

Furthermore, only (18%) of the respondents were mentioned or listed the exact means of transmission of the disease from animal to human. Transmission of the disease to humans were through close contact with infected dogs, drinking water contaminated by dog feces consumption of raw fruits and vegetables contaminated by dog feces and environment contaminated by viable eggs of *E. granulosus* (Tigre, 2012).

6. CONCLUSION AND RECOMMENDATIONS

The present study showed that hepato- pulmonary bovine hydatidosis is prevalent in Jimma area and public awareness about hydatidosis and its transmission method was low in this area. Factors like presence of more stray dogs that visits the abattoir ground and fed on condemned organs, low public awareness about hydatidosis and backyard slaughtering favors the disease transmission in this area.

It is recommended that public health measures such as control of stray dogs and strengthening of meat inspection services at abattoirs should be participated. Home slaughter of cattle should be discouraged, awareness should be created in the public regarding the life cycles of the diseases, regular deworming of dogs and proper disposal of condemned organs at abattoirs. These measures would definitely contribute towards effective control of Cystic *echinococcosis* and reduce the risk of transmission to humans.

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