

**VEGETABLE-TRANSMITTED PARASITES
AMONG INHABITANTS OF EL-PRINCE, ALEXANDRIA
AND ITS RELATION TO HOUSEWIVES' KNOWLEDGE
AND PRACTICES**

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ABSTRACT

In the present study, stool samples were obtained from 575 individuals from El-Prince, a suburban village of Alexandria, Egypt to detect helminthic eggs and protozoan cysts. The results showed that, 35.7% of the sample had at least one vegetable-transmitted parasite, the highest percentage (46.4%) was in the age group of 6 to less than 15 years. The nematode *Ascaris lumbricoides* was the most prevalent in 18.4%, followed by the protozoan *Giardia lamblia* in 10.4%. *Fasciola* eggs were found in 2.4% of samples. Knowledge and practices of housewives concerning *Fasciola* and its source of transmission and methods of washing leafy vegetables was obtained through house-to-house interviews with 303 housewives. Knowledge

that leafy vegetables were a source of *Fasciola* infection was indirectly proportional with age, better in younger housewives and those of secondary or higher education. More than half of the interviewed housewives (57.7%) washed leafy vegetables under running tap water and 32.7% soaked them in tap water. Only 9.6% soaked them in water mixed with a substance as vinegar, lemon juice or common salt. Only 5% of those who were infected with vegetable transmitted parasites washed vegetables by soaking in water with an added substance compared to 19.6% of parasite free housewives. Most of those adding a substance to soaking water (89.7%) used vinegar. Results of the study revealed that a serious and consistent effort through public health activities is essential to educate housewives about vegetable-transmitted parasites, their transmission and ways of prevention.

Key words: *Fasciola*, Vegetable-transmitted parasites, Leafy vegetables, Vinegar.

INTRODUCTION

Vegetables may act as passive vehicles for transmission of pathogenic parasites and protozoa that are primarily transmitted through the fecal-oral route. ^(1,2) These infections can cause serious diseases in infected persons and their impact is due to the vast numbers of persons infected. For example, more than one billion people are infected with the largest intestinal nematode "*Ascaris lumbricoides*". ⁽³⁾ In addition to intestinal parasites, consumption of contaminated leafy green vegetables favors transmission of fascioliasis which has been increasingly reported from rural Egypt since the late seventies. ⁽⁴⁻⁶⁾ Moreover, outbreaks of protozoan infections in humans have been linked to raw fruits and vegetables. ⁽⁷⁾

The major sources of contamination for foods and water are through contact with human or animal fecal wastes. Untreated or contaminated water used for irrigation, as well as the use of fresh untreated manure seem to be likely sources of contamination. ⁽⁸⁻¹⁰⁾ Furthermore, many parasitic contaminants

are part of the environment and fruits and vegetables may be inadvertently contaminated. ⁽¹¹⁾ Contamination typically occurs early in the production process, rather than just before consumption. Presence of these organisms on fresh fruits and vegetables has been extensively documented from both developed and developing countries. ^(1,2,8,9,12)

In Egypt, vegetables form cheap available sources of food and are eaten raw. Given that parasitic infections are common in our community and infection occurs from a lack of knowledge of risks involved at all stages of food preparation, the present study was undertaken. Housewives' recognition of causative agents of diseases that may cause serious chronic sequelae and may be found on green leafy vegetables could have substantial impact on disease prevention. The present study was implemented to determine the percentages of infection with vegetable-transmitted parasites in a suburban village near Alexandria, Egypt and to assess knowledge and practices of housewives about the role of leafy vegetables in *Fasciola* transmission.

SUBJECTS AND METHODS

Study Setting

The study was undertaken in El-Prince, a suburban village of Alexandria, Egypt which has a population of approximately 2,123 individuals. ⁽¹³⁾ Fresh water for domestic purposes is supplied from Alexandria through pipes into most of the houses.

Data Collection

1- Parasitological study

Stool samples were obtained from 575 individuals as a random systematic sample from all age groups. Each individual was given a pre-labeled container and asked to provide a stool specimen which was processed in the Tropical Health Department laboratory of the High Institute of Public Health. Two parasitologic procedures were used:

A- A portion of the sample was preserved in formalin and was later used for detection of parasitic ova and protozoan cysts using the formol-ether sedimentation technique. ⁽¹⁴⁾

B- Three kato-katz slides were also prepared for the diagnosis of helminthes. ⁽¹⁵⁾

2- Assessment of knowledge and practices:

A pre-designed interview questionnaire was constructed to collect data from housewives through house-to-house visits. All housewives were invited to participate in the knowledge and practices' study but only 303 responded (66%). The questionnaire included two parts:

Part 1: Socio-demographic questions about all family members (age, sex, education, etc.)

Part 2: Questions concerning housewives' knowledge about *Fasciola*, its source of transmission, methods of washing leafy vegetables and their satisfaction with their washing method for disease prevention.

Statistical Analysis

Collected data were coded, checked and analyzed using SPSS program version 9.0. Chi square test was used for comparison among proportions. In case of small cell frequency for more than two independent proportions the Monte Carlo two-sided significance was used instead of the chi square test. ⁽¹⁶⁾

RESULTS

I- Infection with vegetable-transmitted parasites

The overall and age-related percentages of infection with parasitic species among El-Prince inhabitants are displayed in table (1) where it is shown that 35.7% have at least one vegetable-transmitted parasite. The highest percentage (46.4%) was in the age group of six to less than fifteen years, while the lowest (23.8%) was found in the age group 35 to less than 45 years. The association with age was statistically significant. ($\chi^2=15.233$, $p<0.05$)

The nematode *Ascaris lumbricoides* was the most prevalent (18.4%) with its highest frequency among children aged 6 to less than 15 years (25.3%) whereas it ranged between 14.3% and 16.3% in all other age groups. The association with age was not statistically significant ($\chi^2= 7.43$, $p> 0.05$). Infections with *Trichuris trichiura* and *Hymenolepis nana* were detected among 4.0% and 3.7% of inhabitants respectively with no statistically significant association with age. *Fasciola* eggs were found in 2.4% of samples. As for protozoan infections, the non-pathogenic *Entamoeba coli* was found in 12.2% of samples. Its results are not shown in the table due to its commensal properties. *Giardia lamblia* was detected in 10.4% of the samples and showed

no statistically significant association with age but infection was more in the younger age groups, decreasing with age reaching 3.2% in the (35-) age group. ($\chi^2 = 10.38$, $p > 0.05$). *Entamoeba histolytica* was found in only 3% of the examined samples.

Figure (1) shows the gender related percentages of infection. *Giardia lamblia* infection was higher among males (13.3%) compared to females (7.9%). All other parasites showed the same trend except for *Entamoeba histolytica*. However the associations with gender were not statistically significant.

II- Housewives' knowledge about source of *Fasciola* infection

The mean age of housewives who participated in the study was 34.62 ± 12.42 years. Knowledge that leafy vegetables were a source of *Fasciola* infection was indirectly proportional to age of the interviewed housewives. (Table 2) Only 4% of those aged more than 40 years gave the correct answer. The percentage increased to 18.2% among those younger than 20 years old. The difference was statistically significant. Knowledge increased with the increase of educational level reaching 22.2% among those having secondary education or higher yet, 77.8% of the same group couldn't know the correct answer. The difference was statistically insignificant.

III - Practices of washing raw eaten leafy vegetable

Table (3) shows that more than half of the interviewed housewives (57.7%) washed leafy vegetables eaten raw under running tap water and 32.7% soaked them in tap water. Only 9.6% soaked in water mixed with a substance as vinegar, lemon juice or common salt. Only 4.6% of the housewives who were below 20 years of age washed vegetables by soaking in water with an added substance. This percentage increased to 10.1% in the older age groups. No statistically significant difference was detected among age groups according to washing methods. As for education, 22.2% of housewives who had a secondary or higher education soaked vegetables in water and an added substance, whereas only 8.8% of illiterates or read and write group practiced this method. However, the difference was not statistically significant. The table also shows that 19.6% of parasite-free housewives washed vegetables by soaking in water with an added substance compared to only 5% among those who were infected with vegetable transmitted parasites. However, the difference was not statistically significant. ($\chi^2 = 2.38$, $p > 0.05$)

Considering substances added to water, tables (4a and 4b) show that there is no statistically significant difference regarding soaking period between

those who added a substance or those who didn't. The highest percentages in both groups used to soak from ten to twenty minutes (82.8% vs. 80.8% respectively). Only 4.7% soak in less than 10 minutes. Also, it is clear that 89.7% of the interviewed housewives put vinegar, 37.9% lemon and 10.3% common salt. Moreover, 37.9% used more than one substance simultaneously.

IV – Housewives' satisfaction with their washing methods

Table (5) displays that, the majority of housewives were satisfied with their washing methods for disease prevention; all of those who soaked with adding a substance, 82.8% of those who soaked in water and 79.4% of washers under running water. It also shows that 17.2% of housewives adding substances to soaking water had correct knowledge about the sources of *Fasciola* infection compared to 12.1% of those who soaked in water and 9.7% of those who washed leafy vegetables under running water. Moreover, only 11.2% of the interviewed housewives gave the correct source of *Fasciola* transmission. Also, there were no statistically significant differences among different groups of washing methods regarding knowing the source of transmission. When asked what *Fasciola* is, only 5.9% gave the right answer.

DISCUSSION

The environmental route of transmission is important for many protozoan and helminth parasites, with water, soil and food being particularly significant. Both the potential for producing large numbers of transmissive stages and their environmental robustness, being able to survive in moist microclimates for prolonged periods of time, pose a persistent threat to public health.⁽¹⁷⁾ *Ascaris* eggs sprayed on tomatoes and lettuce remain viable for up to one month. Metacercariae of *Fasciola* sp. may survive for more than one year on pasture depending on moisture and temperature.⁽¹⁸⁾

Food pathogenicity depends on both the prevalence of pathogens and the quality of food handling. *Ascaris lumbricoides*, *Trichuris trichura*, *Hymenolepis nana*, *Giardia lamblia*, and *Entamoeba histolytica* were all recovered from raw vegetables from many countries with variation in prevalence of specific parasites between countries and regions.^(18, 21) In the present study, vegetable transmitted parasites were found in nearly one third of El-Prince inhabitants; *Ascaris lumbricoides* being the highest species encountered in 18.4%. Both

increased in the school age that may result from age-related patterns of exposure to soil eggs (i.e. different rate of acquisition of infection) and from acquired immunological response to these infections in the older age groups.⁽²²⁾ *Fasciola* sp. that is mainly transmitted through eating raw leafy vegetables was detected among 2.4%. Since the late seventies, human fascioliasis has been increasingly reported from Egypt. In 1998, the population at risk is considered to be 27 millions. Studies in some villages in the Egyptian Nile Delta have revealed prevalence rates ranging between 2% and 17%.⁽²³⁾ Many species of vegetables and weeds are eaten raw, including garden rocket, lettuce, parsley and others. They are not aquatic but are grown along water channel banks and need frequent irrigation. Once collected, they may be washed in the nearby canals during marketing preparations thus exposed to cercariae.⁽²³⁾

Food-borne diseases are for the most part preventable. However, there is an inherent risk with the consumption of certain types of uncooked foods. The choices consumers make about how they handle food at home and about eating food that increases the risk of illness can have an important effect on food-borne disease incidence.⁽²⁴⁾ Our results revealed that most housewives in all age groups and all educational levels had a poor knowledge regarding the sources of *Fasciola* transmission though better in younger housewives and those of secondary or higher education. This indicates that they do not perceive that it is transmitted through vegetables and most of them do not take appropriate measures to protect themselves and their families from this parasite. This ignorance increases the risk of infection. Poor knowledge may be due to the low percentage of inhabitants harboring this parasite, its undiagnosis by local laboratories and its low intensity in infected persons which leads to low pathogenicity, as actual pathogenicity influences risk perceptions through awareness.⁽²⁴⁾ The present study revealed that a minority of housewives washed vegetables adequately; the rest either washed under running water only, or soaked in water or soaked in water adding a substance with insufficient time. Previous studies showed that, washing vegetables with tap water only was associated with higher *Fasciola* prevalence.^(25,26) Other studies showed that only 50% of metacercariae detached from lettuce after 10 minutes exposure to running water, 100% after 10 minutes exposure to vinegar, citric acid and KMnO_4 . The use of both vinegar and KMnO_4 was recommended: the first is lethal to other parasites in the vegetables, the second destroys the metacercariae and vegetable leaves are not softened and remain fresh.^(27,28) In the present study, all chemicals used by housewives for soaking with water

the present study, all chemicals used by housewives for soaking with water were reported to have a detaching effect on metacercariae of *Fasciola*, namely, vinegar, lemon juice and salt. Little is known about the efficiency of disinfectants in killing other parasites on vegetables. ⁽²⁹⁾

Considering association of knowledge with practices, it was found that the higher percentage of housewives who had good knowledge had good practices in vegetable washing. So the assumption that the practice deficits are a function of knowledge deficits is supported by the present study. In studying diarrhoeal diseases, it was found that factors that may negate or weaken the relationships between knowledge and practice include various barriers; cultural factors such as local beliefs about disease causation and classification that may have important implications for the impact and design of health promotion interventions. ^(30,32) The same could be applied to vegetable transmitted parasites. Also, economic barriers ⁽³³⁾ may be important as for example, the cost of chemical disinfectants used in vegetable washing.

Other than the vegetable washing methods, inhabitants may eat outside homes and even on their way home from surrounding fields without adequately washing vegetables. However, it is encouraging that when the method of washing vegetables was related to infection, a smaller percentage of housewives who washed with adding a chemical disinfectant harbored parasites.

CONCLUSION AND RECOMMENDATIONS

Although vegetable-transmitted parasites remain a major public health concern in many parts of the world, particularly the poorest developing countries, cost-effective solutions are both available and deliverable. Such an approach relies largely on epidemiological surveillance, health education, improvement in hygiene and sanitation and regular treatment of high risk groups. Educating people about steps they must take to prevent and control food-borne illness is a vital link in the food preparation chain. Results of the study revealed that a serious and consistent effort through public health activities is essential to educate housewives about vegetable-transmitted parasites, their transmission and ways of prevention. Health education programs should fully describe the impact of infections that can be associated

with raw vegetables. Domestic food handlers should be educated about the principles of personal hygiene and decontamination of vegetables. Identification of the potential sources of vegetable contamination from the environment to the table should be investigated. Instruction in elementary principles of food hygiene at the primary and preparatory school levels is essential as this may be the only education taken by most of housewives in rural and suburban communities in our country.

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Table (1): Percentage Infection of El-Prince Inhabitants with Vegetable Transmitted Parasites According to Age.

Age in years	No. examined	<i>Ascaris lumbricoides</i>		<i>Trichuris trichiura</i>		<i>Fasciola spp.</i>		<i>Hymenolepis nana</i>		<i>Giardia lamblia</i>		<i>Entamoeba histolytica</i>		Total Infected#	
		No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
< 6	77	12	15.6	0	0	2	2.6	2	2.6	12	15.6	1	1.3	21	27.3
6-	166	42	25.3	9	5.4	5	3.0	9	5.4	23	13.9	6	3.6	77	46.4
15-	118	19	16.1	6	5.1	2	1.7	7	5.9	12	10.2	4	3.4	42	35.6
25-	80	13	16.3	6	7.5	2	2.5	2	2.5	4	5.0	2	2.5	28	35.0
35-	63	9	14.3	1	1.6	2	3.2	1	1.6	2	3.2	1	1.6	15	23.8
≥ 40	71	11	15.5	1	1.4	1	1.1	0	0	7	9.9	3	4.2	22	31.0
Total	575	106	18.4	23	4.0	14	2.4	21	3.7	60	10.4	17	3.0	205	35.7
χ^2		7.43		9.19		0.98		7.22		10.38		1.93		15.233*	

* $P < 0.05$

Total infected with at least one parasite.

Table (2): Distribution of Housewives from El-Prince, Alexandria According to their Age, Education and Knowledge.

Variables	Knowledge of Sources of <i>Fasciola</i> Transmission					
	Know n=34 (11.2%)		Do not know n=269 (88.8%)		Total n=303 (100%)	
	No.	%	No.	%	No.	%
1- Age in years						
<20	4	18.2	18	81.8	22	100.0
20-	26	14.3	156	85.7	182	100.0
≥ 40	4	4.0	95	96.0	99	100.0
χ^2	7.91*					
2- Educational level						
Illiterate or read & write	23	9.7	215	90.3	238	100.0
Primary or preparatory	9	16.1	47	83.9	56	100.0
Secondary & above	2	22.2	7	77.8	9	100.0
χ^2	2.99					

* $P < 0.05$

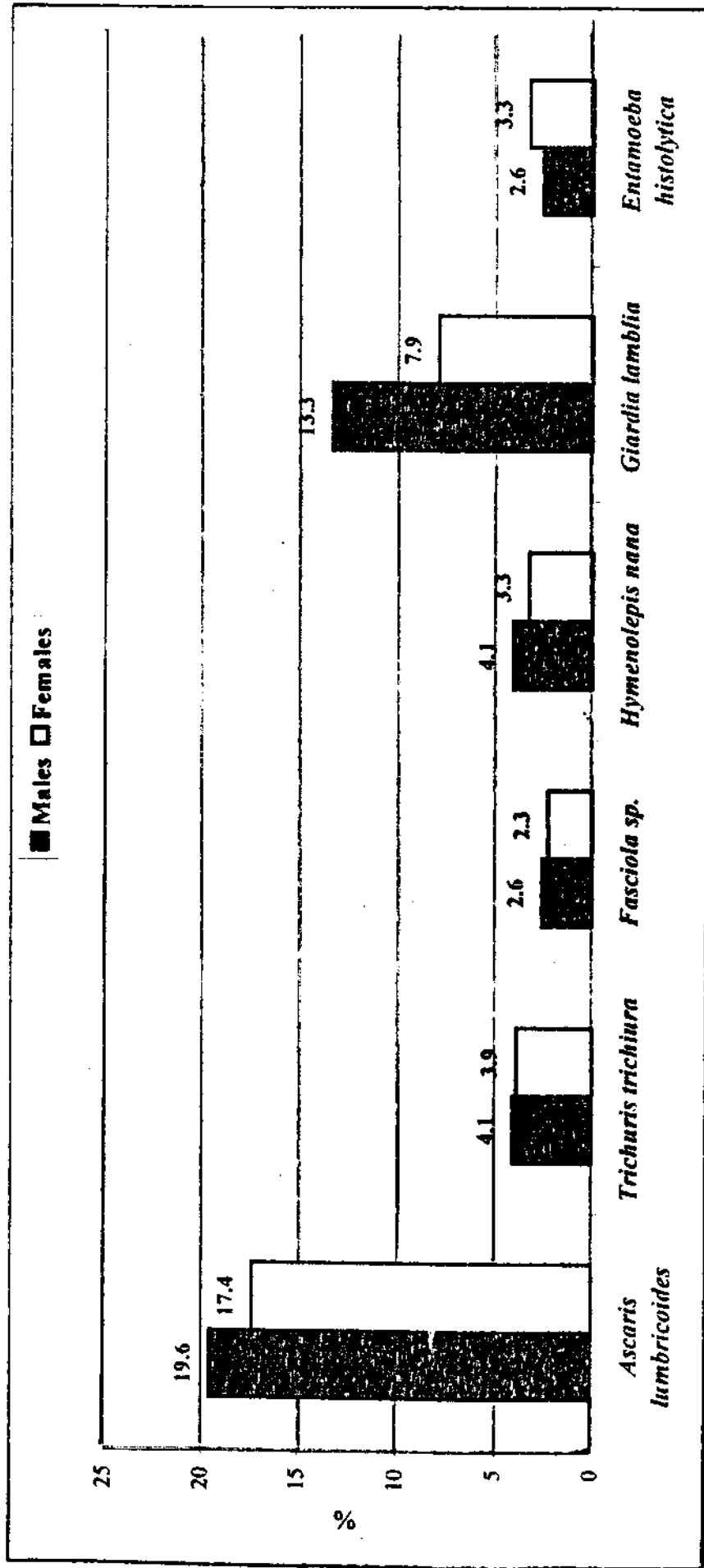


Figure (1): Percentage Infection of El-Prince Inhabitants with Vegetable Transmitted Parasites According to Gender.

Table (3): Distribution of Housewives from El-Prince, Alexandria, According to their Age, Educational Level, Infection with Parasites and Method of Washing Leafy Vegetables.

Variables	Methods of washing raw eaten leafy vegetables							
	Under running water		Soaking in water		Soaking in water with an added substance		Total	
	No.	%	No.	%	No.	%	No.	%
1- Age in years								
<20	12	54.5	9	40.9	1	4.6	22	100.0
20-	102	56.0	62	34.1	18	9.9	182	100.0
≥ 40	61	61.6	28	28.3	10	10.1	99	100.0
Total	175	57.7	99	32.7	29	9.6	303	100.0
χ^2	2.16							
2- Educational level								
Illiterate or read & write	142	59.7	75	31.5	21	8.8	238	100.0
Primary or prep.	27	48.2	23	41.1	6	10.7	56	100.0
Secondary & above	6	66.7	1	11.1	2	22.2	9	100.0
Total	175	57.7	99	32.7	29	9.6	303	100.0
χ^2	5.46							
3-Infection with vegetable-transmitted parasites								
Yes	12	60.0	7	35.0	1	5.0	20	100.0
No	28	50.0	17	30.4	11	19.6	56	100.0
Total	40	52.6	24	31.6	12	15.8	76*	100.0
χ^2	2.38							

* Number of housewives who submitted a stool sample

Table (4a): Distribution of Housewives Soaking Raw Eaten Leafy Vegetables According to Methods and Periods of Soaking and Types of Added Substances.

Soaking in water	Soaking period in minutes							
	<10		10-20		>20		Total	
	No.	%	No.	%	No.	%	No.	%
Without adding a substance	4	4.0	80	80.8	15	15.2	99	100
With adding a substance*	2	6.9	24	82.8	3	10.3	29	100
Total	6	4.7	104	81.2	18	14.1	128	100
χ^2	0.769							

Table (4b): Substances added to the soaking water by the interviewed housewives.

Substance	No.	%
Vinegar	26	89.7
Lemon	11	37.9
Common salt	3	10.3
Number of substances added		
Only one substance	18	62.1
More than one substance	11	37.9

Table (5): Distribution of Housewives from El-Prince, Alexandria According to their Washing Methods, Satisfaction and Knowledge.

Variable	Under running water		Soaking in water		Soaking in water with an added substance		Total	
	No.	%	No.	%	No.	%	No.	%
Satisfied with her washing method								
Yes	139	79.6	82	82.8	29	100.0	250	82.5
No	22	12.6	11	11.1	0	0	33	10.9
Don't know	14	8.0	6	6.1	0	0	20	6.6
Total	175	57.7	99	32.7	29	9.6	303	100.0
χ^2	7.37							
Knowing <i>Fasciola</i> sources of transmission								
Correct answer	17	9.7	12	12.1	5	17.2	34	11.2
Wrong answer or don't know	158	90.3	87	87.9	24	82.8	269	88.8
Total	175	100.0	99	100.0	29	100.0	303	100.0
% #		57.7		32.7		9.6		
χ^2	1.534							

Percentages are calculated from the total interviewed housewives