



Therapeutic effect of honey on acute respiratory infections in adults

[Efecto terapéutico de la miel en las infecciones respiratorias agudas en adultos]

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Abstract

Context: In Morocco, acute respiratory infections (ARI) are a frequent cause of consultations in the first level health facilities. Scientific reports indicate that honey has an important biochemical therapeutic activity.

Aims: To explore the therapeutic effect of honey on ARI in the Guelmim region of southern Morocco.

Methods: This was a prospective clinical study aiming to compare the therapeutic effect of honey in the population that consumes it versus a control population, at the level of the regional hospital and health centers, the period of the study was between September 2022 and March 2023, All the participants were questioned through a questionnaire and the study of their files and monitoring forms.

Results: The study population was divided into two equal groups of 417 people each. Honey significantly reduced the overall symptom score at Day 5 ($p < 0.001$) in the honey group compared with the reference group, according to the ANOVA test, the significant variables are age, presence of associated diseases, duration of illness, number of consultations for respiratory episodes and current smoking status, the present study also shows that non consumption of honey OR = 15.09 [10.26-22.17], high symptom score at D1 OR = 3.85 [2.37-5.39], frequency of nocturnal cough OR = 4.26 [1.65-10.9], frequency of diurnal cough OR = 3.34 [1.5-7.4], duration of illness OR = 7.12 [3.4-14.6] and type of cough OR = 1.5 [1.04-2.2] were the determinants of high symptom score at Day 5.

Conclusions: Honey was effective in relieving symptoms associated with ARI and may be suggested as an adjuvant treatment in adults.

Keywords: acute respiratory infections; adults; cough; honey; symptom score.

Resumen

Contexto: En Marruecos, las infecciones respiratorias agudas (IRA) son una causa frecuente de consulta en los centros sanitarios de primer nivel. Los informes científicos indican que la miel tiene una importante actividad terapéutica bioquímica.

Objetivos: Explorar el efecto terapéutico de la miel sobre las IRA en la región de Guelmim, en el sur de Marruecos.

Métodos: Se trató de un estudio clínico prospectivo con el objetivo de comparar el efecto terapéutico de la miel en la población que la consume frente a una población control, a nivel del hospital regional y centros de salud, el periodo del estudio fue entre septiembre de 2022 y marzo de 2023, Todos los participantes fueron interrogados mediante un cuestionario y el estudio de sus fichas y formularios de seguimiento.

Resultados: La población de estudio se dividió en dos grupos iguales de 417 personas cada uno. La miel redujo significativamente la puntuación global de los síntomas en el día 5 ($p < 0,001$) en el grupo de miel en comparación con el grupo de referencia, según la prueba ANOVA, las variables significativas son la edad, la presencia de enfermedades asociadas, la duración de la enfermedad, el número de consultas por episodios respiratorios y el hábito de fumar actual, el presente estudio también muestra que el no consumo de miel OR = 15,09 [10,26-22,17], la puntuación elevada de los síntomas en el D1 OR = 3,85 [2,37-5,39], la frecuencia de la tos nocturna OR = 4,26 [1,65-10,9], la frecuencia de la tos diurna OR = 3,34 [1,5-7,4], la duración de la enfermedad OR = 7,12 [3,4-14,6] y el tipo de tos OR = 1,5 [1,04-2,2] fueron los factores determinantes de la puntuación elevada de los síntomas en el quinto día.

Conclusiones: La miel fue eficaz para aliviar los síntomas asociados a las IRA y puede sugerirse como tratamiento coadyuvante en adultos.

Palabras Clave: adultos; infecciones respiratorias agudas; miel; puntuación de los síntomas; tos.

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INTRODUCTION

The World Health Organization (WHO) reports that the burden of acute respiratory infections (ARI) remains high despite progress in implementing better treatment and prevention strategies. In Morocco, ARI are a common cause of consultation at primary health care facilities, accounting for 30-50% of consultations (Ministry of Health, 2007). In addition to individual determinants of infection, other determinants such as environmental exposures and social determinants may play an important role in the epidemiology and burden of ARI. According to a survey on ARI in Guelmim (2017), 60% of families use honey as a means of treating ARI (Najat and Dahouss, 2017). Data on these infections in the region show that the total number of ARI cases in 2021 was 12 242 cases, with a prevalence of 2.82%. Acute respiratory symptoms such as wheezing and rapid breathing, dyspnea, sore throat, runny nose, and blocked nose, are the most common acute presentations encountered in general practice in adults with ARI.

Honey is used in many cultures around the world for its medicinal properties. In the 1980s, the scientific community began to explore the use of honey as a therapeutic medium. Scientific reports indicate that honey has significant biochemical therapeutic activity and can help cure diseases. Several studies have claimed the effect of honey on respiratory and general symptoms (Sulaiman et al., 2011). Antibacterial activity is one of the most reported biological properties, with many studies showing that honey is active against clinically important pathogens. The Moroccan Ministry of Health encourages the use of harmless remedies such as honey and lemon (Ministry of Health, 2005).

This study aims to compare the therapeutic effect of honey in the honey-consuming population versus a reference population in adults with ARI in the Guelmim region, southern Morocco.

MATERIAL AND METHODS

Ethical considerations

This study was approved by the Ethics Committee for Biomedical Research of Mohammed V University, Faculty of Medicine and Pharmacy of Rabat, Morocco, on 26/09/2022 under number 57/22. The survey was conducted only after obtaining the study participants' prior agreement and informed consent (questionnaire semi-administered by investigators). All guidelines per Helsinki's declaration and good clinical practice guidelines were followed.

Type and population of the study

This was a prospective observational study matched (1:1) by age and pathology, conducted among patients with an acute respiratory infection, from September 2022 to March 2023 and included by seven nurses and five doctors. The subjects were users of health centers and the regional hospital of Guelmim in southern Morocco. They were divided into two groups: 1) Honey group (HG), composed of patients with ARI, who consume honey as a complementary therapeutic means. They were not vaccinated against influenza and received a medicinal treatment 2) Reference group (RG), also composed of patients with ARI and not vaccinated against influenza, received the same medicinal treatment without complementary consumption of honey.

Inclusion criteria: cases aged 18 years and older, with ARI, clinically and/or biologically diagnosed, not vaccinated against influenza, receiving the same drug treatment. The investigators included all treatments commonly used in usual care; no other prophylactic agents were used by the subjects.

Exclusion criteria: The study excluded the presence of diseases that could affect the use of honey as an adjuvant to medical treatment (food and pollen allergy, fructose intolerance, caries sensitivity).

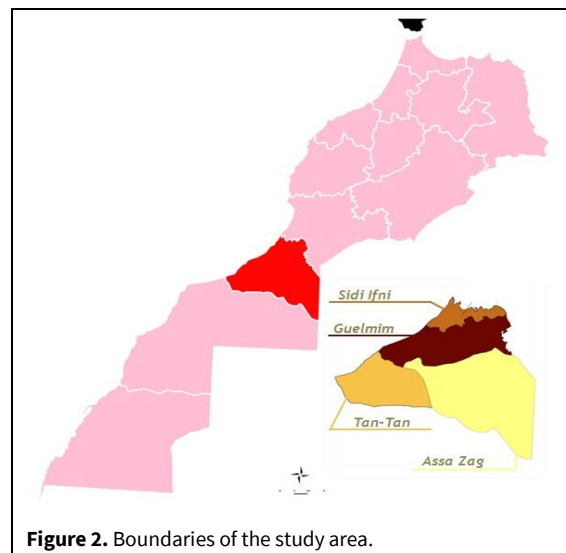
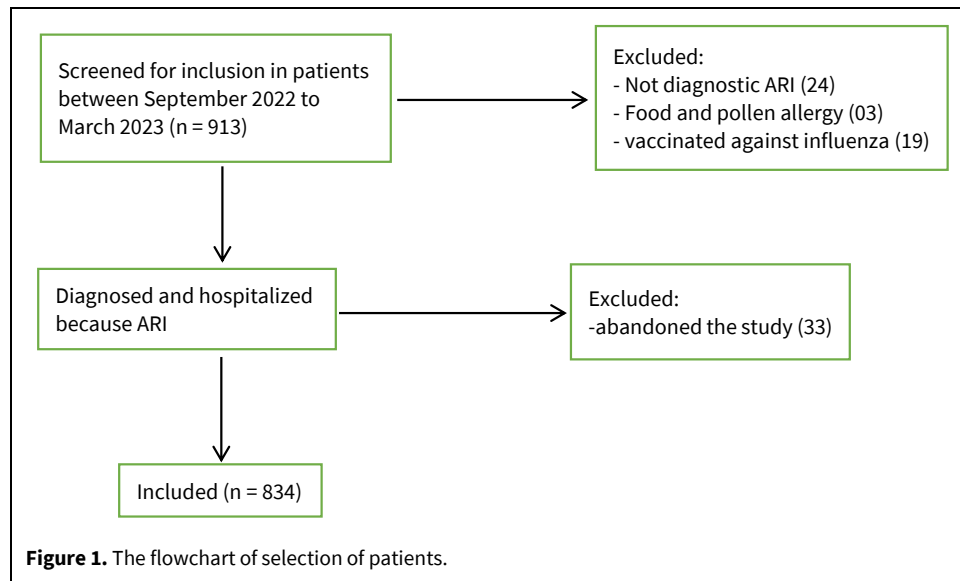
The study adopted a census of all persons with the inclusion criteria who presented to the health facilities during the study period (n = 834) (Fig. 1).

Questionnaire/patient file

Participants were interviewed using a questionnaire in Arabic (translated into French), including a section on respiratory signs (wheezing, rapid breathing, dyspnea, sore throat, runny nose, blocked nose) and a section on clinical signs (appetite, asthenia, headache, and vomiting). Chart review (Fig. 1) and monitoring forms: (a) socio-demographic data, (b) clinical data, (c) classification, (e) treatment, and (f) history of ARF.

The questionnaire adopted the Canadian Influenza and Respiratory Illness Scale (CARIFS) (Jacobs et al., 2000). The clinical status was assessed in 2 steps: day 1 (D1) and day 5 (D5). It was composed of 10 items that represented the different symptoms: They were scored from 1 to 4 according to the Likert scale (no problem = 1, minor problem = 2, moderate problem = 3, and major problem = 4).

The questionnaire was pre-tested on 10 patients before the study began (see supplementary data). The reliability test, assessed by Cronbach's alpha, yielded



a coefficient of 0.89, indicating robust internal consistency among the 44 items analyzed. This coefficient exceeds the established minimum threshold of 0.70 (Peterson, 1995). The remarkable internal consistency strengthens the credibility and validity of the scale used in the study.

Complementary therapy

The authors chose a matched study design, i.e., cases and referents received the same drug treatment to avoid the effect of additional treatment. This matching was done according to age and pathology, and a list of drugs was made according to patient number (see supplementary data).

Study area

The Guelmim area represents 6.49% of the surface of Morocco and has 433,757 inhabitants. Concerning

the provision of respiratory health care, there is a regional hospital and 8 first-level urban health centers that offer preventive care, in addition to a public health laboratory and a diagnostic center for tuberculosis and respiratory diseases (Regional Directorate Guelmim Care Provision Service, 1/12020) (Fig. 2).

Statistical analysis

Categorical variables are presented as proportions, and continuous variables are presented as mean and standard deviation (SD). Univariate logistic regression analysis was performed between variables. Statistically significant differences between groups were tested using the Wilcoxon test, chi-squared test, or Fisher's exact test, as appropriate. An in-depth cross-analysis of the various factors was conducted. This was used to describe the similarities/differences between the groups. The symptom score was calculated by assigning the same weight to symptoms for both

Table 1. Socio-demographic data of the population at inclusion.

Characteristics (n = 834)					
Age; n (%)	18-28	28-38	38-48	48-58	>58
	56 6.7%	56 6.7%	302 36.2%	278 33.3%	142 17%
Gender; n (%)	Female		Male		
	352 42.2%		482 57.8%		
Education level; n (%)	Illiterate	Primary	Secondary	University	
	289 34.7%	171 20.5%	217 26.0%	151 18.1%	
Family status; n (%)	Single	Married	Divorced	Widowed	
	125 15%	664 80%	31 4%	14 1%	
Professional status; n (%)	Working	Retired	Not working	Casual work	
	284 34.1%	176 21.1%	203 24.3%	171 20.5%	
Origin; n (%)	Rural		Urban		
	380 45.6%		454 54.4%		

n: frequency; %: percentage.

periods Day 1 and Day 5. Then, this score was discretized into two categories: patients with a low symptom score vs. patients with a high symptom score. Finally, a logistic regression multivariate model with a backward elimination procedure was computed to identify factors associated with higher symptom scores. This model included the studied clinical signs. Independent variables included in the model were also those showing a $p < 0.05$ in bivariate analysis. All analyses were performed with SAS software version 9.4.

RESULTS

The population ($n = 834$) is divided into two groups of people, according to their use ($n = 417$) or not ($n = 417$) of honey; the distribution of age is similar, with approximately 69.5% of the participants between 38 and 58 years. There was also a slight male predominance (58%). The sample included 54.4% from urban areas, the majority of participants were married (80%), 34.7% of participants were illiterate, followed by those with secondary education (26%), and the majority of participants were actively employed (34.1%), followed by those who were unemployed (24.3%) (Table 1).

For the symptoms of "wheezing" and "rapid breathing", 55.6% of patients in the reference group (RG) patients having no problem (NP) on day 1 (D1) developed minor problems (MP) starting from day 5 (D5). The patients of the honey group (HG) having a major problem (MPR) and moderate problem (MOP) have all passed to the MP stage (100%) ($p < 0.0001$).

About the third symptom "dyspnea", the results of the RG showed that 65% of the patients with MOP were improved to MP ($p < 0.0001$). While for the HG, all patients with MOP or MPR at the beginning of the study were improved to a MP stage. Moreover, 68% of the RG patients with a sore throat, who were classified as MP, remained in the same stage, while all HG patients with MOP stage improved to no sore throat at D5 ($p < 0.0001$).

Regarding "runny nose" and "stuffy nose", a percentage of RG (68%) without any problem at the beginning of the study developed PM. Regarding HG, 100% of patients with MOP and MPR on D1 improved to a PM stage for a runny nose, and half of the sore throat patients (56%) with MOP on D1 improved to a NP stage ($p < 0.0001$).

Table 2. Evolution of the respiratory and general symptoms for the honey group.

Scale dimensions and items	No problem		Minor problem				Moderate problem				Major problem					
	D1		D5		D1		D5		D1		D5		D1		D5	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Wheezing	78	18.71	34	8.15	185	44.36	330	79.14	118	28.30	35	8.39	36	8.63	18	4.32
Rapid breathing	56	13.43	28	6.71	288	69.06	361	86.57	51	12.23	17	4.08	22	5.28	11	2.64
Dyspnea	84	20.14	42	10.07	259	62.11	343	82.25	41	9.83	18	4.32	33	7.91	14	3.36
Sore throat	92	22.06	379	90.89	290	69.54	22	5.28	18	4.32	9	2.16	17	4.08	7	1.68
Runny nose	70	16.79	131	31.41	230	55.16	151	36.21	93	22.30	99	23.74	24	5.76	36	8.63
Stuffy nose	83	19.90	41	9.83	169	40.53	311	74.58	133	31.89	50	11.99	32	7.67	15	3.60
Appetite	152	36.45	275	65.95	219	52.52	117	28.06	20	4.80	10	2.40	26	6.24	15	3.60
Asthenia	94	22.54	49	11.75	236	56.59	309	74.10	67	16.07	49	11.75	20	4.80	10	2.40
Headache	82	19.66	41	9.83	227	54.44	301	72.18	70	16.79	56	13.43	38	9.11	19	4.56
Vomiting	64	15.35	32	7.67	303	72.66	360	86.33	28	6.71	14	3.36	22	5.28	11	2.64

N: frequency; %: percentage; D1: day 1; D5: day 5.

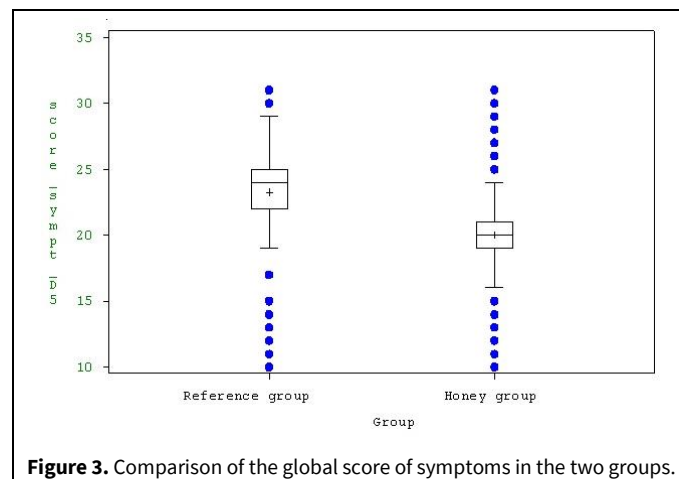


Figure 3. Comparison of the global score of symptoms in the two groups.

Cross-analysis of general symptoms showed similar results, e.g., for asthenia, all patients in the RG (100%) who initially had an appetite PM or MOP remained in the same stage. While patients in the HG who initially had an appetite MPR also displayed a significant improvement ($p < 0.0001$), with 69% being improved to a PP stage. However, for the HG, a percentage of 100% who were in MOP were improved to the PM stage towards the end of the study ($p < 0.0001$) (Table 2).

The quantitative analysis of the data was based on the calculation of a global score of the symptoms. For the RG, the mean score in D1 was 21.4 ± 5.2 vs. 23.2 ± 3.7 in D5, comparatively to the HG where the mean score in D1 was 20.0 ± 4.9 vs. 19.9 ± 4.0 in D5, the baseline conditions were the same, with a more or less close average. After 5 days, the HG ended up with a

lower score. Both scores on D1 and D5 were normally distributed ($p < 0.001$). The variance was 27.6 in D1 vs. 14 in D5, compared to the GR, whose mean score was 24.3 in D1 vs. 16.3 in D5 in the HG (Fig 3).

Included patients (58.27%) had a duration of illness between 5 and 10 days. It is also noted that 60% of patients only visited once a year for a respiratory episode. In addition, out of a total of 834 patients, 92.93% (775) were no-smokers.

According to the ANOVA test, the significant variables were age, presence of associated diseases, duration of illness, number of consultations for respiratory episodes, and current smoking status. The most frequently used type of honey was Saharan plants (37.17%; $p < 0.0001$), followed by eucalyptus (21.58%), orange (16.31%), euphorbia (12.47%), thyme (8.63%), flowers (2.40%), and thistle (1.44%) (Fig. 3).

Table 3. Correlation study between the variables.

Variable	Score D5	Age	Sex	Score D1	Associated diseases	Type of ARI	Current smoker	Severity of cough D1	Frequency of nocturnal cough D1	Frequency of daytime cough D1	Duration of illness	Type of cough	Respiratory episode visits/year
Score D5	1.00000	0.04559 0.1884	0.00101 0.9768	0.48434 <0.0001	-0.23698 <0.0001	0.00491 0.8873	-0.17171 <0.0001	0.14885 <0.0001	0.15005 <0.0001	0.11886 0.0006	0.21982 <0.0001	0.24552 <0.0001	0.17618 <0.0001
Age	0.04559 0.1884	1.00000	0.15160 <0.0001	0.01791 0.6055	0.03104 0.3706	0.01558 0.6533	0.00434 0.9005	0.07037 0.0422	0.05560 0.1086	0.05534 0.1103	0.04922 0.1555	0.08216 0.0176	0.04903 0.1572
Sex	0.00101 0.9768	0.15160 <0.0001	1.00000	-0.01206 0.7281	-0.00315 0.9276	0.01406 0.6852	0.00026 0.9940	-0.00235 0.9459	0.00376 0.9136	0.00017 0.9962	-0.00568 0.8698	-0.01730 0.6178	0.00993 0.7747
Score D1	0.48434 <0.0001	0.01791 0.6055	-0.01206 0.7281	1.00000	-0.07704 0.0261	-0.00491 0.8875	-0.17415 <0.0001	0.35979 <0.0001	0.21688 <0.0001	0.24090 <0.0001	0.19339 <0.0001	0.17330 <0.0001	0.21001 <0.0001
Associated diseases	-0.23698 <0.0001	0.03104 0.3706	-0.00315 0.9276	-0.07704 0.0261	1.00000	-0.00166 0.9619	0.02188 0.5280	-0.01900 0.5837	-0.01947 0.5745	-0.02803 0.4188	-0.16911 <0.0001	0.00346 0.9206	-0.16262 <0.0001
Type of ARI	0.00491 0.8873	0.01558 0.6533	0.01406 0.6852	-0.00491 0.8875	-0.00166 0.9619	1.00000	-0.03563 0.3040	-0.01304 0.7069	-0.02315 0.5043	-0.02175 0.5306	-0.02519 0.4675	0.21232 <0.0001	-0.02539 0.4641
Current smoker	-0.17171 <0.0001	0.00434 0.9005	0.00026 0.9940	-0.17415 <0.0001	0.02188 0.5280	-0.03563 0.3040	1.00000	-0.22830 <0.0001	-0.26206 <0.0001	-0.27495 <0.0001	-0.22098 <0.0001	-0.05814 0.0934	-0.17850 <0.0001
Severity of cough D1	0.14885 <0.0001	0.07037 0.0422	-0.00235 0.9459	0.35979 <0.0001	-0.01900 0.5837	-0.01304 0.7069	-0.22830 <0.0001	1.00000	0.90477 <0.0001	0.91537 <0.0001	0.84078 <0.0001	0.14857 <0.0001	0.88683 <0.0001
Frequency of nocturnal cough D1	0.15005 <0.0001	0.05560 0.1086	0.00376 0.9136	0.21688 <0.0001	-0.01947 0.5745	-0.02315 0.5043	-0.26206 <0.0001	0.90477 <0.0001	1.00000	0.96773 <0.0001	0.87172 <0.0001	0.13819 <0.0001	0.89920 <0.0001
Frequency of daytime cough D1	0.11886 0.0006	0.05534 0.1103	0.00017 0.9962	0.24090 <0.0001	-0.02803 0.4188	-0.02175 0.5306	-0.27495 <0.0001	0.91537 <0.0001	0.96773 <0.0001	1.00000	0.86831 <0.0001	0.13047 0.0002	0.90845 <0.0001
Duration of illness	0.21982 <0.0001	0.04922 0.1555	-0.00568 0.8698	0.19339 <0.0001	-0.16911 <0.0001	-0.02519 0.4675	-0.22098 <0.0001	0.84078 <0.0001	0.87172 <0.0001	0.86831 <0.0001	1.00000	0.13078 0.0002	0.90637 <0.0001
Type of cough	0.24552 <0.0001	0.08216 0.0176	-0.01730 0.6178	0.17330 <0.0001	0.00346 0.9206	0.21232 <0.0001	-0.05814 0.0934	0.14857 <0.0001	0.13819 <0.0001	0.13047 0.0002	0.13078 0.0002	1.00000	0.08160 0.0184
Respiratory episode visits/year	0.17618 <0.0001	0.04903 0.1572	0.00993 0.7747	0.21001 <0.0001	-0.16262 <0.0001	-0.02539 0.4641	-0.17850 <0.0001	0.88683 <0.0001	0.89920 <0.0001	0.90845 <0.0001	0.90637 <0.0001	0.08160 0.0184	1.00000

*P<0.05 statistically significant. Pearson correlation coefficients, n = 834. Prob > |r| under H0: Rho = 0.

Correlation analysis was performed on 13 variables and the symptom score on day 5 (SSD5). The correlation coefficient between symptom score in D5 vs. D1 was (0.48; p<0.0001); strong correlations were found between cough severity in D1 vs. (night cough frequency (0.97), day cough frequency (0.91), duration of illness (0.84), respiratory episode consultations (0.88) p<0.0001). Additional correlations were found between diurnal cough frequency in D1 vs. (diurnal cough severity (0.9), nocturnal cough frequency (0.96), duration of illness (0.87), consultations for a respiratory episode (0.89); p<0.0001). Also, correlations were found between Daytime cough frequency in D1 vs. (cough severity (0.91), nighttime cough frequency (0.96), duration of illness (0.86), and respiratory episode consultations (0.9); p<0.001). Finally, strong correlations were found between the duration of illness in D1 vs. (cough severity (0.84), nocturnal cough frequency (0.87), daytime cough frequency (0.86), respiratory episode consultations (0.9); p<0.001), and between the respiratory episode consultations in D1 vs. (cough severity (0.88), night cough frequency (0.89), day cough frequency (0.90), duration of illness (0.9); p<0.0001) (Table 3).

The study showed that the no-consumption of honey OR = 15.09 [10.26-22.17], the high symptom score in D1 OR = 3.85 [2.37-5.39], nocturnal cough frequency OR = 4.26 [1.65-10.9], diurnal cough frequency OR = 3.34 [1.5-7.4], duration of illness OR = 7.12 [3.4-14.6] and type of cough OR = 1.5 [1.04-2.2] were the determinants of the high symptom score in D5 (Table 4).

DISCUSSION

The present study showed that the no-consumption of honey has a positive effect on people with ARI. Indeed, HG presents a lower severity of symptoms in D5. The mean score of symptoms in the RG was 23.2 ± 3.7 vs. 9.0 ± 4.0 in the HG. Moreover, the present study shows that the no-consumption of honey OR = 15.09 [10.26-22.17], the high symptom score in D1 OR = 3.85 [2.37-5.39], nocturnal cough frequency OR = 4.26 [1.65-10.9], diurnal cough frequency OR = 3.34 [1.5-7.4], duration of illness OR = 7.12 [3.4-14.6], and type of cough OR = 1.5 [1.04-2.2] were the determinants of the high symptom score in D5.

Table 4. Multivariate analysis in 834 patients with ARI indicating variables associated with higher symptom score adjusted by age and sex.

Odds ratio estimates			
Effect	OR adjusted	CI 95% (min-max)	
RG vs. HG	15.090	10.267	22.177
higher vs. lower symptom score	3.582	2.377	5.398
Infrequent vs. frequent night cough	4.265	1.655	10.995
Infrequent vs. frequent daytime cough	3.349	1.503	7.461
Higher vs. lower illness duration	7.124	3.459	14.673
Oily vs. dry cough	1.513	1.040	2.201

RG: Reference group; HG: Honey group.

Interventional research on the effect of honey on pilgrims showed a difference in the average symptom score between honey consumers and non-consumers, which was reduced over time; this result was found in other studies (Mariam et al., 2014; Ouaamr et al., 2023) which and confirmed by the study.

In this study, 86% of the patients with an MP sore throat in D1 have been improved in D5. These results have been confirmed by another study, which showed that the relief of symptoms was faster in the HG (Nanda et al., 2017). In addition, another study dealt with the effectiveness of syrup based on honey and herbs in reducing the symptoms of acute non-productive cough and throat irritation, among others. Better results on the duration of relief were found towards the end of this study (Gupta et al., 2016).

Other studies have shown the efficacy of honey for the symptomatic improvement of ARI. Indeed, Paul et al. (2007) demonstrated that there are significant differences in the improvement of symptoms, with honey consistently obtaining the best score and no treatment the worst. Similar results were reported by a Turkish study (Carr and Nahata, 2006). The CARIFS score of symptoms improved in a significantly shorter time (days 2 and 4). Patients receiving antibiotic therapy with honey showed a higher cure rate than the antibiotic group alone ($p < 0.05$) (Seçilmiş and Silici, 2020).

Its properties can explain these positive results of honey. Several studies have dealt with the antibacterial activity of honey. This action is closely related to the plant source, the metabolism of bees, storage conditions, processing procedures, and the environment, which have a great influence on its chemical and physical properties, including its antibacterial properties (Almasaudi et al., 2017; Al-Nahari et al., 2015).

The most active antimicrobial component of honey compounds is hydrogen peroxide. Other factors such as acidity, hyperosmolarity, and antioxidant activity have also been implicated. These factors can inhibit

bacterial growth and toxin production (Al-Waili et al., 2011).

In addition, recent research has demonstrated its potential against various viral infections. honey produces actions against (a) influenza, (b) dengue virus, (c) viral hepatitis, (d) human immunodeficiency virus (HIV), (e) poliovirus type 1, (f) rabies, (g) gingivostomatitis, (h) herpes simplex virus type 1. The antioxidant properties of honey have been highlighted recently, it is rich in flavonoids and phenolic acids, and other antioxidants that have several preventive effects against different respiratory diseases (Cianciosi et al., 2018).

Another study on the positive effects of honey gargles showed no significant difference between the two groups regarding cough and sore throat, but the hoarseness score was lower in the experimental group ($p = 0.05$). The passage of time had a significant effect ($p < 0.001$)

Contrary to the results of this study, which showed the association between honey use and the duration of the disease ($p < 0.0001$), a study (Paul et al., 2007) confirmed that the average duration of the disease was not significantly different between ($p = 0.15$), However, both studies showed a similar pattern of symptom modification, and the days of the disease decreased with the use of honey (Paul et al., 2007).

Moreover, the majority of patients in this study used local honey (37.17%), which is composed of several Saharan plants (euphorbia, cactus, thistle, jujube), followed by eucalyptus (21.58%), both types are dark honey. Several studies have shown a correlation between antioxidant capacity and color, with darker honey providing the highest levels of antioxidants (Boutoub et al., 2021). However, it is not possible to confirm that dark honey is more effective than light honeys, since comparative studies on their effects have not been carried out so far.

Furthermore, the present study was based on a questionnaire, which may be considered a limitation, but clinicians often base their decisions on subjective assessments of symptom severity. A percentage of improvement can also be attributed to the natural course of ARI, which improves with time and management (Jacobs et al., 2000).

Another limitation is that the evaluation period is a bit short (D1, D5). To increase the reliability and usefulness of the results, it is suggested that the evaluation period should have been more extended. This would have resulted in more reliable results and adequate validity; more extended evaluation periods can also increase the accuracy of measurements and analyses.

The strength of this study is that the baseline conditions were the same; the study had a representative sample (n = 834), which means the results were more significant. The matching conditions were essential to ensure that the study groups were comparable and that the results were not biased; they were based on different criteria such as age and pathology. In addition, the WHO has listed honey as an adjuvant treatment for cough, but there are few studies on its use in adults. The majority of research is conducted in children and treats the symptoms of cough (World Health Organization, 2015), which is different from this study, which was conducted in adults.

CONCLUSION

No consumption of honey, high symptom score, nocturnal cough frequency, diurnal cough frequency, duration of illness, and type of cough were associated with the high symptom score. The present study is the first study in Morocco that deals with the positive effect of honey on ARI in adults, and it deals with both inpatient and outpatient settings.

Based on these results, honey can be proposed as an adjuvant treatment for ARI in adults. However, it is important to note that these results are based on a specific clinical study and cannot be generalized to the whole population. Further studies are needed to confirm these results and determine the underlying mechanisms of the beneficial effect of honey.

CONFLICT OF INTEREST

The authors declare no conflicts of interest.

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REFERENCES

- Almasaudi SB, Al-Nahari AAM, Abd El-Ghany ESM, Barbour E, Al Muhayawi SM, Al-Jaouni S, Azhar E, Qari M, Qari YA, Harakeh S (2017) Antimicrobial effect of different types of honey on *Staphylococcus aureus*. Saudi J Biol Sci 24(6): 1255–1261. <https://doi.org/10.1016/j.sjbs.2016.08.007>
- Al-Nahari AA, Almasaudi SB, Abd El-Ghany el SM, Barbour E, Al Jaouni SK, Harakeh S (2015) Antimicrobial activities of Saudi honey against *Pseudomonas aeruginosa*. Saudi J Biol Sci 22(5): 521–525. <https://doi.org/10.1016/j.sjbs.2015.04.006>
- Al-Waili NS, Salom K, Butler G, Al Ghamdi AA (2011) Honey and microbial infections: A review supporting the use of honey for microbial control. J Med Food 14(10): 1079–1096. <https://doi.org/10.1089/jmf.2010.0161>
- Boutoub O, El-Guendouz S, Manhita A, Dias CB, Estevinho LM, Paula VB, Carlier J, Costa MC, Rodrigues B, Raposo S, Aazza S, El Ghadraoui L, Miguel MG (2021) Comparative study of the antioxidant and enzyme inhibitory activities of two types of Moroccan *Euphorbia* entire honey and their phenolic extracts. Foods 10(8): 1909. <https://doi.org/10.3390/foods10081909>
- Carr RR, Nahata MC (2006) Complementary and alternative medicine for upper-respiratory-tract infection in children. Am J Health Syst Pharm 63(1): 33–39. <https://doi.org/10.2146/ajhp040613>
- Cianciosi D, Forbes-Hernández TY, Afrin S, Gasparri M, Reboredo-Rodríguez P, Manna PP, Zhang J, Bravo Lamas L, Martínez Flórez S, Agudo Toyos P, Quiles JL, Giampieri F, Battino M (2018) Phenolic compounds in honey and their associated health benefits: A review. Molecules 23(9): 2322. <https://doi.org/10.3390/molecules23092322>
- Gupta A, Gaikwad V, Kumar S, Srivastava R, Sastry J (2016) Clinical validation of efficacy and safety of herbal cough formulation “Honitus syrup” for symptomatic relief of acute non-productive cough and throat irritation. Ayu 37(3-4): 206–214. https://doi.org/10.4103/ayu.AYU_156_15
- Jacobs B, Young NL, Dick PT, Ipp MM, Dutkowski R, Davies HD, Langley JM, Greenberg S, Stephens D, Wang EE (2000) Canadian Acute Respiratory Illness and Flu Scale (CARIFS): Development of a valid measure for childhood respiratory infections. J Clin Epidemiol 53(8): 793–799. [https://doi.org/10.1016/s0895-4356\(99\)00238-3](https://doi.org/10.1016/s0895-4356(99)00238-3)
- Mariam SH, Zegeye N, Tariku T, Andargie E, Endalafar N, Aseffa A (2014) Potential of cell-free supernatants from cultures of selected lactic acid bacteria and yeast obtained from local fermented foods as inhibitors of *Listeria monocytogenes*, *Salmonella* spp. and *Staphylococcus aureus*. BMC Res Notes 7: 606. <https://doi.org/10.1186/1756-0500-7-606>
- Ministry of Health (2005) Child health policy, situation analysis. Ministry of Health and Social Protection Rabat, Morocco.
- Ministry of Health (2007) Multiple Indicator National Survey and Youth Health. Ministry of Health and Social Protection Rabat, Morocco.
- Najat C, Dahouss R (2017) The management of lower respiratory infections in children under 05 years of age at the level of c/s Elmassira, Tayert, and rjaflah and pediatric service, Higher Institute of Nursing and Health Technology Guelmim, Morocco.
- Nanda M, Mittal S, Gupta V (2017) Role of honey as adjuvant therapy in patients with sore throat. Natl J Physiol Pharm Pharmacol 7(4): 412–415.
- Ouaamr A, Aberhouch N, Cherrah Y, Katim A (2023) The effects of honey on cough and sleep quality in adults with acute respiratory infections. Chinese J Otorhinolaryngol Head Neck Surg 58(5): 873–885.

- Paul IM, Beiler J, McMonagle A, Shaffer ML, Duda L, Berlin CM Jr (2007) Effect of honey, dextromethorphan, and no treatment on nocturnal cough and sleep quality for coughing children and their parents. *Arch Pediatr Adolesc Med* 161(12): 1140-1146. <https://doi.org/10.1001/archpedi.161.12.1140>
- Peterson RA (1995) A meta-analysis of the Cronbach alpha coefficient. *J Consumer Res* 21(2): 381-391. <https://www.jstor.org/stable/2489828>
- Seçilmiş Y, Silici S (2020) Bee product efficacy in children with upper respiratory tract infections. *Turk J Pediatr* 62(4): 634-640. <https://doi.org/10.24953/turkped.2020.04.013>
- Sulaiman SA, Hasan H, Deris ZZ, Wahab MSA, Yusof RC, Naing NN, Othman NH (2011) The benefit of Tualang honey in reducing acute respiratory symptoms among Malaysian Hajj pilgrims: A preliminary study. *J ApiProduct ApiMedical Sci* 3(1): 38-44.
- World Health Organization (2015) *World Health Statistics 2015*. <https://www.who.int/docs/default-source/gho-documents/world-health-statistic-reports/world-health-statistics-2015.pdf> [Consulted: 15 December 2023].

AUTHOR CONTRIBUTION:

Contribution	Ouaamr A	Mekkaoui M	Ouaalaya E	Aziz M	Cherrah Y	Alaoui K
Concepts or ideas	x	x	x	x	x	x
Design	x	x	x	x	x	x
Definition of intellectual content	x		x		x	x
Literature search	x	x		x		
Clinical trial	x				x	
Data acquisition	x	x	x	x	x	x
Data analysis	x		x		x	
Statistical analysis			x		x	x
Manuscript preparation	x		x	x		x
Manuscript editing	x		x		x	x
Manuscript review	x	x	x	x	x	x

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Supplementary data

Royaume du Maroc
Université Mohammed V –Rabat
Faculté de Médecine et de Pharmacie



المملكة المغربية
جامعة محمد الخامس –الرباط
كلية الطب والصيدلة

ADDITIONNEL INFORMATION**1-Fiche d'Enquête****1. DONNEES/INFORMATION GENERALES:**

Age: Date de naissance:.....

Sexe: M F

Date d'enregistrement:/...../.....

2. INFORMATIONS SPECIFIQUES:

Etat Matrimonial: Célibataire Marié Divorcé Veuf

Nombre d'enfants:

Niveau d'instruction: Primaire Collège/lycée Université Analphabète

Provenance: Urbaine Rurale

Profession: Actif Retraité Sans travail Travail occasionnel

Couverture médico-sociale: oui non

3. L'usage du miel:

Vous utilisez le miel: oui non

CARACTERISTIQUES CLINIQUES ET EPIDEMIOLOGIQUES:**PROVENANCE ET CONTEXTE DE DIAGNOSTIC:**

Urgence Référence Consultation externe Recours spontané au système de soins

PATHOLOGIES ASSOCIEES:

Aucune pathologie Hypertension artérielle Diabète Asthme Autres

Type des IRA:

-IRA Basses: Pneumonie Bronchite Bronchiolite

-IRA Hautes: Rhinopharyngite Angine Otite Sinusite aiguë

Signes cliniques généraux:**Température:**

Jours	1 ^{er}	5 ^{eme}
Valeurs		

Signes fonctionnels respiratoires:

A- Toux

A-1-aDurée:

Durée	<5 jours	5-10 jours	10-15 jours

A-1-bSévérité de la toux:

	Léger	Modéré	Grave	Sévère	Très Sévère
Jour 1					
Jour 5					

A-1-c la fréquence:

La toux du jour

	Absent	Pendant une courte période (environ quelques minutes)	Pendant 2 courtes périodes (environ 10 minutes)	toux fréquente qui n'interfère pas avec les activités normales	Toux gênante pendant la majeure partie de la journée
Jour 1					
Jour 5					

La toux nocturne

	Absent	Seulement au réveil/seulement avant de s'endormir	Se réveille une fois/se réveille tôt à cause de la toux	Toux fréquente pendant la majeure partie de la nuit	Toux dérangeante
Jour 1					
Jour 5					

A-3-Type de toux:

Toux grasse Toux sèche

B-Soulagement respiratoire:

Items	Jours	Pas de problème	Problème mineure	Problème modéré	Problème majeur
Respiration sifflante	Jour 1				
	Jour 5				
Respiration rapide	Jour 1				
	Jour 5				
Dyspnée	Jour 1				
	Jour 5				
Mal de gorge	Jour 1				
	Jour 5				
Écoulement nasal	Jour 1				
	Jour 5				
Nez bouché	Jour 1				
	Jour 5				
Appétit	Jour 1				
	Jour 5				
Asthénie	Jour 1				
	Jour 5				
Céphalée	Jour 1				
	Jour 5				
Vomissement	Jour 1				
	Jour 5				

C- Combien de Visites avez-vous fait dans un établissement de santé pour épisode respiratoire par année:

1

2

3

4

5

2- Drug list

Outpatient acute community-acquired pneumonia in adults		
Situations	Patient numbers	Medications used of first choice
Without signs of severity Suspicion of pneumococcus	1-30	Amoxicillin 1 G
Doubt between pneumococcus and atypical bacteria	30-56	Amoxicillin 1 G or Pristinamycin 1G
Suspicion of atypical bacteria	56-120	Macrolide
Subjects with co-morbidity or elderly subjects without signs of ravity	120-199	Macrolide Amoxicillin + Clavulanic acid
Cases with cough	199-289	Dextromethorphan or Diphenhydramine 50 mg
Acute community-acquired pneumonia		
Pneumonia outside the influenza context		
Situations	Patient numbers	Medications used of first choice
Young subjects without comorbidity Elderly subjects with or without comorbidity	289-389	Cefotaxin IV 1G + Glycopeptide Ceftriaxone 1G IV + Amikacin 30 mg + Macrolide IV
Cases with cough	389-465	Dextromethorphan or Diphenhydramine 50 mg
Pneumonia with influenza-like illness		
General cases	465-561	Ceftriaxone 1 G IV + Macrolide IV
Severe pneumonia	561-601	Cefotaxin IV 1G + Glycopeptide + Clindamycin 600 mg
Cases with cough	601-688	Dextromethorphan or Diphenhydramine 50 mg
Acute sinusitis		
General cases	688-756	Amoxicillin 1 G
Allergic cases	756-773	Cefuroxism 500 mg
Acute pharyngitis		
General cases	773-783	Amoxicillin 500 mg
Allergic cases	783-791	Cefadroxil 1g or Azithromycin 500 mg
Acute bronchitis		
General cases	791-812	Amoxicillin 500 mg
Allergic cases	812-816	Cefadroxil 1g or Azithromycin 500 mg
Angina		
General cases	816-832	Amoxicillin 1G Penicillin V Cefuroxime
Allergic cases	832-834	Erythromycin 500 mg Azithromycin 500 mg