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Sociodemographic Risk Factors for Dermal Infections with Methicillin Sensitive and Methicillin Resistant *Staphylococcus aureus* among Sheep Breeders in Diyala Governorate , Iraq

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Abstract

Background: *Staphylococcus aureus* is one of the dominant pathogen among skin infections in human and animals.

Objective: To isolation and identification of S.aureus from sheep breeders by traditional method &Automated Vitek 2 system ,Detection of methicillin resistant gene (mecA) by conventional PCR. Evaluation of relationship between S.aureus in-fection and possible risk factors in human (age, sex, education level, economic statue, hospitalization in last four weeks contact with sheep skin lesions, and contact with pets).

Patients and Methods: A total of 44 skin swaps collected from sheep breeders suffered from variety of infected skin lesions (wounds, abscesses, atopic dermatitis, acne, chronic skin diseases etc.) recording; sex, age, education level, economic statue, hospitaliza-tion in last four weeks, contact with sheep skin lesions, and contact with pets to detect S. aureus, MRSA and estimating the risk factors, by employing traditional laboratories methods in addition to confirmatory techniques by VETEK2 sys-tem and PCR, using specific primers (Staur 4, 6), MRSA gene primers (mecA).

Results: Methicillin sensitive S. aureus was reported in 34.09% versus40% for MRSA among sheep breeders. Significant correlation reported between age groups and MRSA infections. Although, the rate of infection with methicillin sensitive S. aureus and MRSA was higher among males compared with females , no signifi-cant correlation reported between sex and infection with methicillin sensitive S. aureus and MRSA. Female breeders were at high risk for getting dermal MRSA infections compared with males. No significant correlation between the educa-tion level, economic status, contact with pets and methicillin sensitive S. aure-us , MRSA infections as Risk factors. Methicillin sensitive S. aureus infections among breeders significantly correlated with hospitalization in last four weeks .Significant correlation reported between contact with skin lesions of sheep and methicillin sensitive S. aureus , MRSA infections among breeders.

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Conclusion: Methicillin resistant trait was common among S.aureus isolated from sheep breeders .MRSA infections correlated with age. Female sheep breeders were at high risk for getting S.aureus and MRSA infections. Sex , education level, eco-nomic status, contact with pet play no role in infection with S.aureus. hospitali-zation in last four weeks, contact with skin lesions correlated significantly with S. aureus, MRSA infections among breeders.

Keywords: *S. aureus*, skin, sheep breeders, risk factors

Introduction

Since 1880 when Alexander Ogston, microscopically obtained a groups of bacteria in sur-gical wound pus, named it Staphylococcus due to its appearance, later in 1884, Rosen-bach distinguished over golden pigmentation colonies (aureus) as genus type[1] ,Coccids Gram-positive cluster-forming, spherical cell 0.5-1 micrometer diameter, non-motile, non-spore forming, glucose and mannitol fermenter, produce catalase and coagulase, smooth yellow colonies; aerobically or anaerobically (facultative), able to grow at 15-45 C, even at NaCl salt concentration 15%, able to stay alive over dry atmosphere from days to sea-sons [2] , belongs to the Phylum; firmicutes, Family; Staphylococcaceae, Class; Bacilli close genetically relatives, genus; Bacillus, same level of family Listeriaceae which is also a nearby family [3] ,While MRSA is strain; natively unlike via methicillin compounds re-sistant, developed genetically or picked up horizontally by biomarker gene transfer, lead-ing to several difficulty in treating infections with methicillin antibiotic groups [4].

Emergence MRSA have been reported in livestock also, where three different types termed; (HA-MRSA), (CA-MRSA) and (LA-MRSA), those infections have gained im-portance due to limitation of treatment possibilities against highly zoonotic MRSA [5], cross-species infections between humans and animals were documented for certain strains of MRSA too [6]".

MRSA was registered in numerous locations of the planet as probable causes life threat-ing, septicemia forming, bone and cardiac disorders in mankind, while wildlife might playing potential role to infect accompanier human [7], particularly, emergence increasing occurrences of LA-MRSA in hospitals and aggressive infections in humans [8-10].

Current study was designed for isolation and identification of *S.aureus* from sheep breeders by traditional method &Automated Vitek 2 system ,Detection of methicillin re-sistant gene (*mec*A) by conventional PCR. Evaluation of relationship between S.aureus infection and possible risk factors in human (age, sex, education level, economic statue, hospitalization in last four weeks contact with sheep skin lesions, and contact with pets).

Patients and Methods

Study Area And Study Population

This study was conducted on sheep breeders living in south east distracts of Diyala gov-ernorate (Baladruze, Baqubah, Kanaan and Buhruz - 33°45'34.71"N;44°36'23.97"E ,Northeast [11-16].

Collection of Samples

A total of 44 skin swap samples collected from sheep breeders suffering from variety

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of skin infections then sent to laboratory for initial isolate on mannitol salt agar for 18-24h and golden yellow colonies were selected for further investigation; (Gram staining, Ni-grosin capsule staining, catalase test, coagulase test, DNase), identified S. aureus and (MRSA) through Vitek2 System and PCR Which applied for detection of *S. aureus* us-ing the specific primer(Staur 4, 6).

Molecular Diagnosis for *S. aureus*

Conventional PCR was applied, for detection of *S. aureus* by specific primer

Staur 4	**5'- ACGGAGTTAC AAA GG ACG AC-3'**
Staur 6	5'-AGCTCAGCCTT AACGAGT A C-3'

Detection of MRSA: A biomarker mecA primer used for (MRSA) detection

Methicillin Resistant Gene A(*mec*A)	***mec*A-F**	**162bp**	**5-TCCAGATTACAACTTCACCAGG-3**
	*mec*A-R		3-CCACTTCATATCTTGTAACG-5

Statistical Analysis

Calculation down by the Statistical Package of the Social Sciences for windows version 17 (SPSS, Armonk, NY: IBM Corp) [28, 29]. Pearson's chi-square and Pearson's correlation coefficient was utilized for the correlation between the changeable of 2 test. P value of ≤ 0.05 and ≤ 0.01(2-tailed) were set to be statistically important [30, 31].

Results

Among 44 sheep breeders submitted in this study whom suffered from different skin diseases, S. aureus involved among 15 of them rated (34.09%) of collected samples from skin lesion which grew positively on mannitol salt agar, confirmed by Vitek 2 system and conventional PCR by using *S. aureus* 23s RNA gene sequence specific primer (staur 4 and staur 6) as shown in Figure (1), while a total of 6/15, (40%) were (MRSA), represents (13.63%) of total samples according to methicillin resistance on Muller Hinton medium and results of conventional PCR by using *S. aureus* (mecA gene) as shown in Figure (2), Table (1) Show *S. aureus* infections were concentrated at the age group (11-20) years, (11.36%) and (51-60) years, (13.63%), still MRSA was concentrated at old ages (51-60) years, (11.36%) and (61-70years), (2.27%). No significant difference ($\chi 2=25.827$; p value =0.583), neither correlation (R=0.196; p value =0.203) were reported amongst age groups via S. aureus infections in sheep breeders, but Significant positive correlation (R=0.441; p-value =0.003) were reported amongst age groups of MRSA infections among sheep breeders.

As shown in Table (2) *S. aureus* and MRSA infections were concentrated among males 13/44, (29.54%) versus 5/44, (11.36%), while females infection with S. aureus represent only 2/44 (4.54%) versus 1/44, (2.27%) with MRSA, No significant difference ($\chi 2=0.002$; p value =0.966), neither correlation (R=-0.006; p-value =0.967) were reported amongst sex via S. aureus infections among breeder. Neither significant difference ($\chi 2=0.002$; p value =0.816), nor correlation (R=-0.035; p-value =0.821) reported mid sex via MRSA breeder infections.

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Table (1): Correlation between Isolation Rate of *S. aureus*, MRSA and age of Sheep Breeders

Age	Type of isolates from skin lesions of sheep breeders			
	S. aureus		MRSA	
	Positive (%)	**Negative (%)**	**Positive (%)**	Negative (%)
11-20	5(11.36%)	9(20.45%)	0(0%)	14(31.81%)
21-30	1(2.27%)	5(11.36%)	0(0%)	6(13.62%)
31-40	0(0%)	4(9.09%)	0(0%)	4(9.09%)
41-50	0(0%)	3(6.81%)	0(0%)	3(6.81%)
51-60	6(13.63%)	6(13.63%)	5(11.36%)	7(15.90%)
61-70	3(6.81%)	2(4.54%)	1(2.27%)	4(9.09%)
Total	15(34.09%)	29(65.90%)	(13.63%)	38(86.36%)
χ^2	25.827		29.848	
P value	0.583		0.371	
R	0.196		0.441	
P value	0.203		0.003	

Table (2): Correlation between isolation rates of *S. aureus*, MRSA and Sex of Breeders

Type Of Isolates From Skin Lesions Of Sheep Breeders					
Sex	*S. aureus*		MRSA		
	Positive	Negative	Positive	Negative	Total
Female	2(4.54%)	4(9.09%)	1(2.27%)	5(11.36%)	6(13.62%)
Male	13(29.54%)	25(56.81%)	5(11.36%)	33(75%)	38(86.36%)
Total	15(34.09%)	29(65.90%)	6(13.62%)	38(86.36%)	44(100%)
χ^2	0.002		0.054		
P value	0.966		0.816		
R	0.006		-0.035		
P value	0.967		0.821		

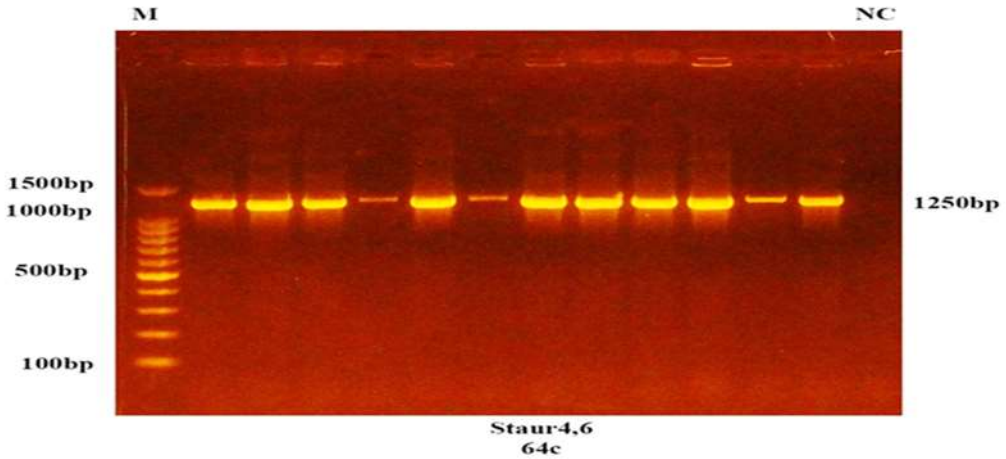

Figure (1): Amplification for staur primers staur 4&6 (1250bp) by conventional PCR for *S. aureus* recovered from skin lesions of sheep breeder. NC: Negative control

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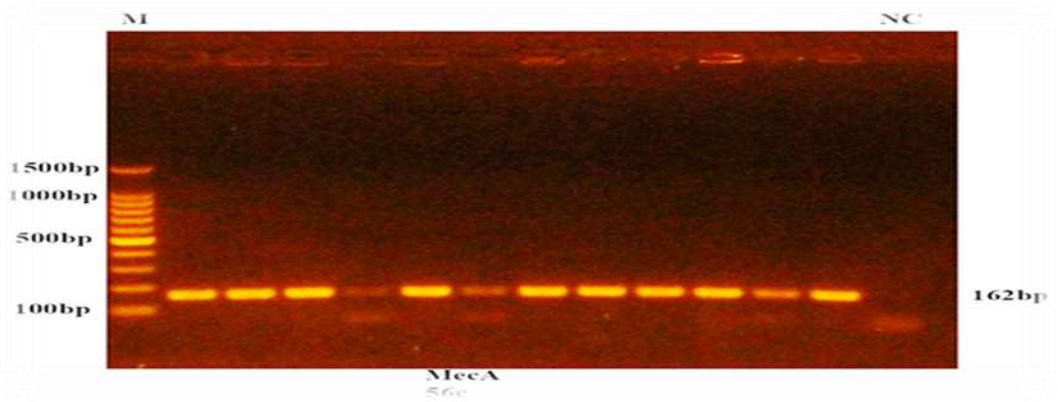

Figure (2): Amplification MecA (162bp) by conventional PCR for *S. aureus* recovered from skin lesions of sheep breeder. NC: Negative control

Risk factors for infection with S. aureus and MRSA among sheep breeders

A-Sex

As shown in Table (3), the probability of female infection with *S. aureus* (odds ratio) was (1.042) time greater than males. The risk estimate for male to get infection with *S. aure-us* was (0.995) time compared with (1.034) for females. The probability of female infec-tion with MRSA or (odds ratio) was (0.758) time greater than males, the risk estimate for male to get infection with MRSA was (1.042) time compared with (0.789) for females .

B-Education level

As shown in Table (4), *S. aureus* and MRSA infections were concentrated among primary educated sheep breeders 9/44, (20.45%) versus 3/44, (6.81%), while breeders with sec-ondary education have infection with *S. aureus* represent only 3/44 (6.81%) versus 2/44, (4.54%) with MRSA. Neither significant difference ($\chi 2$=0.783; p value =0.376), nor cor-relation (R=-0.133; p-value =0.388) were reported between education level and *S. aureus* infections among breeders, neither significant difference ($\chi 2$=0.054; p value =0.816), non-correlation (R=--0.035; p-value =0.821) were reported between education level and MRSA infections among breeders.

The probability of (illiterate / educated) to get infected with *S. aureus* or (odds ratio) was (0.462) time, the probability of (illiterate / educated) infection with MRSA or (odds ratio) was (0.758) time. The risk estimate for illiterate to get infection with *S. aureus* was (0.517) time compared with (1.121) for educated sheep breeders, the risk estimate for il-literate to get infection with MRSA was (0.789) time compared with (1.042) for educated .

C-Economic status

As shown in Table (5), *S. aureus* and MRSA infections were concentrated among breed-ers with middle economic status 8/44, (18.18%)Versus 4/44, (9.09%), while sheep breed-ers with low economic status have infection with *S. aureus* represent only 7/44, (15.90%) versus 2/44, (4.54%) with MRSA, Neither significant difference ($\chi 2$=0.013; p value =0.908), nor correlation (R=--0.018; p-value =0.910) reported amid economic status via *S. aureus* infections of breeders. Neither significant difference ($\chi 2$=0.412; p value =0.521), nor correlation (R=--0.097; p-value

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=0.532) were reported amid economic status via MRSA infections of sheep breeders, the probability of (low / Middle) Economic status to get infected with *S. aureus* or (odds ratio) was (0.929) time, the risk estimate for low to get infection with *S. aureus* was (0.961) time compared with (1.034) for middle Econom-ic status among sheep breeders, the probability of (low /Middle) Economic status to get infected, with MRSA or (odds ratio) was (1.800) time, the risk estimate for low to get infection with MRSA was (1.421) time compared with (0.789) for middle Economic sta-tus among sheep breeders.

D-Hospitalization in Last four Weeks

As shown in Table (6), *S. aureus* infections were reported among breeders whom hospital-ized last four weeks 6/44, (13.63%) versus 9/44, (20.45%) have positive infection without hospitalization in last 4 weeks. MRSA infections were reported among breeders whom hospitalized in last four weeks 4/44, (9.09%) versus 2/44, (4.54%) have positive infection without hospitalization in last four weeks. Significant difference ($\chi 2$ = 4.051; p value = 0.044) and correlation (R = 0.303; p value = 0.045) were reported between hospitalization in last four weeks and S. aureus infections among sheep breeders. Neither significant dif-ference ($\chi 2$=2.353; p value =0.125), neither correlation (R= 0.231; p-value =0.131) were reported between hospitalization in last four weeks and MRSA infections among sheep breeders. The probability of skin lesions of sheep breeders which hospitalized in last four weeks (odds ratio) and the estimated risk for infection with *S. aureus* among sheep breeders was not detected statistically. The risk estimate for infection with *S. aureus* among sheep breeders that did not hospitalized in last four weeks was(1.154) time. The probability of skin lesions of sheep breeders which hospitalized in last four weeks (odds ratio) was (7.400). The estimated risk for infection with MRSA among sheep breeders which hospitalized in last four weeks was (0.158). While the risk estimate for infection with MRSA among sheep breeders that did not hospitalized in last four weeks was (1.168) time.

E-Contact with skin lesions of sheep

As shown in Table (7), *S. aureus* infections were reported among sheep breeders wh0m contacted with skin lesion of sheep 14/44, (31.81%) versus 1/44, (2.27%) have positive infection without contact with skin lesion of sheep, Significant difference ($\chi 2$= 9.811; P value = 0.002) and correlation (R = 0.472; P value = 0.001) were reported amid contacted with sheep skin lesions via *S. aureus* infections within sheep breeders. The probability of skin lesions of sheep infected with S. aureus or (odds ratio) was (17.231) time, risk esti-mate for contact with skin lesions of sheep infected with S. aureus among sheep breeders was (0.113) time compared with (0.480) for risk estimate for sheep to infect s with S. au-reus from human source . As shown in Table (8) MRSA infections were reported among sheep breeders which contacted with skin lesion of sheep 3/44, (6.81%) versus 3/44, (6.81%) have positive infection without contact with skin lesion of sheep .The probability of skin lesions of sheep infected with *S. aureus* or (odds ratio) was (17.231) time, risk es-timate for contact with skin lesions of sheep infected with *S. aureus* among sheep breed-ers was

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(0.113) time compared with (0.480) for risk estimate for sheep to infect s with *S. aureus* from human source . As shown in Table (8) MRSA infections were reported among sheep breeders which contacted with skin lesion of sheep 3/44, (6.81%) versus 3/44, (6.81%) have positive infection without contact with skin lesion of sheep.. Significant difference ($\chi 2$=4.728; P value = 0.003) and correlation (R = 0.328; P = 0.03) were report-ed in the middle of contact with skin lesions of sheep and MRSA infections among sheep breeders, the probability of skin lesions of sheep infected with MRSA or (odds ratio) was (6.600) time, the risk estimate for contact with skin lesions of sheep infected with MRSA among sheep breeders was (0.263) time compared with (0.222) for risk estimate for sheep to infect s with MRSA from human source.

F. Contact with pets

As shown in Table (9), *S. aureus* infections were reported among sheep breeders which Contact with pets 13/44, (29.54%) versus 2 /44, (4.54%) have positive infection without Contact with pets. All MRSA infections were reported among sheep breeders whom Contact with pets, 6/44, (13.63%), Neither Significant difference ($\chi 2$=0.360; p value =0.549) neither correlation (R= 0.090; p-value =0.559) were reported amongst Contact with pets via *S. aureus* infections on sheep breeders. Neither Significant difference ($\chi 2$=1.544; p value =0.214), nor correlation (R= 0.187; p-value =0.223) were reported among Contact with pets and MRSA infections of sheep breeders. The probability of skin lesions of sheep breeders whom Contact with pets (odds ratio) was (1.696) and the esti-mated risk for infection with S. aureus among sheep breeders was (0.915).The risk esti-mate for infection with *S. aureus* among sheep breeders that did not contact with pets was (1.552) time. The probability of skin lesions of sheep breeders whom Contact with pets (odds ratio) was (3.6230) and the estimated risk for infection with MRSA among sheep breeders which Contact with pets was (0.789).

Table (3): Sex of Sheep Breeders as a risk factor for infection with *S. aureus* and MRSA

Type Of Isolates From Skin Lesions Of Sheep Breeders					
Sex	***S. aureus***		**MRSA**		
	Positive	**Negative**	**Positive**	**Negative**	**Total**
Female	2(4.54%)	4(9.09%)	1(2.27%)	5(11.36%)	6(13.62%)
Male	13(29.54%)	25(56.81%)	5(11.36%)	33(75%)	38(86.36%)
Total	15(34.09%)	29(65.90%)	6(13.62%)	38(86.36%)	44(100%)
Odds ratio for sex (Female/Male)	Value	95% CI	Value	95% CI	
	1.042	0.168-6.450	0.758	0.073 - 7.896	
Risk estimate for male	0.995	0.778-1.272	1.042	0.714 - 1.522	
Risk estimate for female	1.034	0.213-5.016	0.789	0.110 - 5.643	

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Table (4): Education level of Sheep breeders as a risk factor of infection with *S. aureus*, MRSA

Type of Isolates From Skin Lesions of Sheep Breeders					
Education level	***S. aureus***		**MRSA**		
	Positive	**Negative**	**Positive**	**Negative**	**Total**
Illiterate	3(6.81%)	3(6.81%)	1(2.27%)	5(11.36%)	6(13.63%)
Primary	9(20.45%)	18(40.90%)	3(6.81%)	24(54.54%)	27(61.36%)
Secondary	3(6.81%)	8(18.18%)	2(4.54%)	9(20.45%)	11(25%)
Total	15(34.09%)	29(65.90%)	6(13.63%)	38(86.36%)	44(100%)
X2	0.783		0.054		
P value	0.376		0.816		
R	-0.133		-0.035		
P value	0.388		0.821		
Odds ratio for education (illiterate / educated)	Value	95% CI	Value	95% CI	
	0.462	0.81-2.63	0.758	0.73-7.896	
Risk estimate for illiterate	0.517	0.118-2.258	0.789	0.110-5.643	
Risk estimate for educated	1.121	0.846-1.485	1.042	0.714-1.522	

Table (5): Economic statusof Sheep Breeders as risk factor for *S. aureus* and MRSA infections

Type Of Isolates From Skin Lesions Of Sheep Breeders					
Economic status	***S. aureus***		**MRSA**		
	Positive	**Negative**	**Positive**	**Negative**	**Total**
Low	7(15.90%)	13(29.54%)	2(4.54%)	18(40.90%)	20(45.45%)
Middle	8(18.18%)	16(36.36%)	4(9.09%)	20(45.45%)	24(54.54%)
High	0(0%)	0(0%)	0(0%)	0(0%)	0(0%)
Total	15(34.09%)	29(65.90%)	6(13.63%)	38(86.36%)	44(100%)
X2	0.013		0.412		
P value	0.908		0.521		
R	-0.018		0.097		
P value	0.910		0.532		
Odds ratio for economic status (Low / Middle)	Value	95% CI	Value	95% CI	
	0.929	0.226-3.244	1.800	0.294-11.031	
Risk estimate for Low economic status	0.961	0.489- 1.887	1.421	0.437-4.625	
Risk estimate for middle economic status	1.034	0.582-1.840	0.789	0.416- 1.499	

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Table (6): Hospitalization in Last four Weeks as a risk factor for S. aureus and MRSA infection among sheep breeders

Type Of Isolates From Skin Lesions Of Sheep Breeders					
Hospitalization In Last 4 Weeks	***S. aureus***		**MRSA**		
	Positive	**Negative**	**Positive**	**Negative**	**Total**
Yes	6(13.63%)	6(13.63%)	4(9.09%)	8(18.18%)	6(13.63%)
No	9(20.45%)	23(52.27%)	2(4.54%)	30(68.18%)	38(86.36%)
Total	15(34.09%)	29(65.90%)	6(13.63%)	38(86.36%)	44(100%)
X2	4.051		2.353		
P value	0.044		0.125		
R	0.303		0.231		
P value	0.045		0.131		
Odds Ratio for Hospitalization In Last 4 Weeks	Value	95% CI	Value	95% CI	
	ND		7.400	0.397-137.879	
Risk estimate for yes Hospitalization In Last 4 Weeks	ND		0.158	0.011- 2.201	
Risk estimate for No Hospitalization In Last 4 Weeks	1.154	0.946- 1.407	1.168	0.814- 1.677	

Table (7): Contact with Sheep skin lesions as risk factor for *S. aureus* infection among breeders

Type Of Isolates		*S. aureus* from skin lesion of Human		Total
		No	**Yes**	
S. aureus from skin lesion of sheep	Negative	16(36.36%)	1(2.27%)	17(38.63%)
	Positive	13(29.54%)	14(31.81%)	27(61.36%)
Total		29(65.90%)	15(34.09%)	44(100%)
X2		9.811		
P Value		0.002		
R		0.472		
P Value		0.001		
Odds Ratio for *S. aureus* to infect sheep (negative / positive)		**Value**	CI 95%	
		17.231	1.994- 148.921	
Risk estimate for sheep to infect s with *S. aureus*		0.480	0.314-0.735	
Risk estimate for human to infect s with *S. aureus*		0.113	0.016-0.786	

Table (8): Contact with Sheep skin lesions as a risk factor for MRSA infection among breeders

Type Of Isolates		MRSA from skin lesion of Human		Total
		No	**Yes**	
MRSA from skin lesion of sheep	Negative	33(75%)	3(6.81%)	36(81.81%)
	Positive	5(11.36%)	3(6.81%)	8(18.18%)
Total		38(86.36%)	6(13.63%)	44(100%)
X2		4.728		
P Value		0.03		
R		0.328		
P Value		0.03		
Odds Ratio for *MRSA* to infect sheep (negative / positive)		**Value**	CI 95%	
		6.600	1.031-42.238	
Risk estimate for sheep to infect s with MRSA		0.263	0.084-0.826	
Risk estimate for human to infect s with MRSA		0.222	0.055-0.906	

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Table (9): Contact with pets as a risk factor for *S. aureus* and MRSA infections among breeders

Type Of Isolates From Skin Lesions Of Sheep Breeders					
Contact with pets	***S. aureus***		**MRSA**		
	Positive	**Negative**	**Positive**	**Negative**	**Total**
Yes	13(29.54%)	23(52.27%)	6(13.63%)	30	36(81.81%)
No	2(4.54%)	6(13.63%)	0(0%)	8(18.18%)	8(18.18%)
Total	15(34.09%)	29(65.90%)	6(13.63%)	38(86.36%)	44(100%)
X2	0.360		1.544		
P value	0.549		0.214		
R	0.090		0.187		
P value	0.559		0.223		
Odds Ratio for Contact with pets	**Value**	95% CI	**Value**	95% CI	
	1.696	0.298-9.649	3.6230	0.1849- 70.9901	
Risk estimate for yes Contact with pets	0.915	0.697-1.201	0.789	0.670-0.930	
Risk estimate for No Contact with pets	1.552	0.355-6.775	ND		

Discussion

Current results revealed, that 15 out of 44 sheep breeders whom suffered dermal diseases were infected with *S. aureus* isolate rate (34.09%), by biological tests includes MSA which isolate, selects and differentiated G positive cluster like coccid positive for Coagu-lase, Catalase DNase tests respectively according to [32,33],then confirmed by Vitek 2 system which goes with[34,35] , later conventional PCR by using *S. aureus* gene se-quence 23sRNA specific primer (staur 4,6) according to [36] , whereas MRSA was 6/15 rated (40%), confirmed by methicillin resistance on Muller Hinton media depending on [37, 38], results of conventional PCR by using *mec*A gene and blaz gene of *S. aureus* [39, 40], those ratio varied around the world, while in Brazil [41], showed that the rate of *S. aureus* cutaneous infections was (51.8%) and (41.6%) for (MRSA) and the difference due to the variations of sample collections between breeders. On the other hand, [9]described *S. aureus* as a popular human pathogen 33% of seemingly healthy cases, but [42]said that *S. aureus* colonizes the nares of 28-32% of the world population. While in Egypt *S. aureus* esteemed 36.4% [43]. likewise [42] stated that *S. aureus* represent 34.5% and MRSA 41.7% among clinical isolates in Nepal, In Germany hospitals MRSA infec-tion rates was 44.4%, a regularity of 9% among them infects by roommate patron [44]. Justified ratio mentioned by [45] about sheep farms workers in Italy, *S. aureus* isolate 35.5% the nearest to current findings.

In this study demonstrates parallel between infection rate of *S. aureus* and MRSA infection rates inconsistency of age were nearly at young 11.36% and old 13.63%. On the oth-er hand, the infection with MRSA was concentrated at the old age group 51-60 years, 11.36% and 61-70years, in 2.27%, but significant positive correlation noticed between the age groups and MRSA, in China [46] revealed that a total of 61.3 % old patients infect-ed by MRSA, also [47] claimed that children could act as reservoirs of MRSA,[48] viewed the age-standardized rates for deaths were higher in males MRSA

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colonization and more common in those aged 65 years or older, although [49] believed that most con-sistent predictor of mortality is age, with older patients being twice as likely to die.

As per current study *S. aureus* infection rates 29.4% male verses 4.54% female, also MRSA male higher 11.36% than female 2.27%, some researchers reported male S. aureus infection rates higher than female [50]in India and UK male 57.5% female 42.2%, others find the contrary [51] in Asfahan find male infection ratio 43.8 % less than female 56.2%, [52] ,in Ethiopia found 33.2% in males less than females 68.8%.On the other hand [53]thoughts that chemicals and cosmetic material might play roles. Despite [39],reported MRSA rates were lower in males than females, on other hand [54], believed that estrogen had tough roll and influence upon skin thickness, prevent infections with *S. aureus,* role of sex hormones in modulation immune response and susceptibility for infection among males and females, steroid hormones have important character in skin physiology, immun-ity, skin architecture, thickness of dermis and epidermis layers [55,56] . Estrogens associ-ated with immune-enhancement but androgens led to immunosuppression [57].

Education level

This study shows three level of education of sheep breeders whom infected with *S.aureus* (3 Illiterate, 9 primary, 3 secondary) rated (6.81 , 20.45, 6.81 %), versus MRSA (1 Illiterate, 3 primary, 2 secondary) rated (2.27, 6.81, 4.54%) respectively, the higher con-centrated among primary educated sheep breeders, but there is no correlation, significant-ly variation, no direct influences on infection rates. While in Ethiopia [52] ,reports highest isolate among Illiterate 52.2%, mid upon Secondary and above educated 26.6% but lesser on Elementary 21.2 %. On the other hand [58] reported that S. aureus was recovered from 34.9% healthy veterinarians, while MRSA was recorded among 47.6 %. These re-sults were come in agree with [59] who estimated that additional education might be de-crease the risk factors.

Economic statue

This study calculated no significant variation among sheep breeders whom infected with S. aureus (7 low /8 Middle), economic status with zero high economic status people be-ings, but the low economic status 2 got double time chances less to infects with MRSA compared with middles 4 by risk estimating which might be due to their ability to deal with medicines and treatments in case of any argents, even with no medical prescriptions, which come in line with [49] about socioeconomic status which is known to impact a pa-tient's infection risk, an counter relationship exists between incidence and Socioeconomic, with the lowest rates found for the least deprived economic strata than for the most de-prived strata, researchers [59]claim predictively that socioeconomic status and family in-come related to risk factor significantly, also [60]figure that *S. aureus*, MRSA infection is associated with poorer clinical outcomes". "Economic state mostly related to incomes, financial benefits, thus [58] stated that staphylococci carried among healthy people with no reported risk of colonization (15.9%), food handlers (7.8%), Veterinarians (34.9%) and livestock farmers (27.1%).

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Although S. aureus and MRSA widespread in healthy humans, due to contact with livestock and veterinary practice seems to increase the risk of carrying MRSA, jobs which increase their economic state, thus, emphasizes the need for integrated molecular epidemiology of zoonotic staphylococci.

Hospitalization in last four weeks

Risk estimation among sheep breeders whom hospitalized in last 4 weeks to get infected with *S. aureus* wasn't record, but sheep breeders whom not hospitalized in last 4 weeks to get infected with *S. aureus* was (1.154), while sheep breeders whom hospitalized in last 4 weeks to get infected with MRSA was (0.158) time compare with risk estimate for sheep breeders to get infected MRSA from not hospitalized in last 4 weeks (1.168) time. Insur-ing the assumption of hospital role in splitting MRSA, [61] ,stated Although advancing age by itself is not considered a risk factor for MRSA infection, but age more than 65 years is a significant risk factor for hospitalization hence, advancing age is indirectly linked to MRSA acquisition.

Contact with sheep skin lesions

Contact with sheep skin lesion risk estimation among sheep breeders to get infected with *S. aureus* was (0.113) time compare with risk estimate for sheep to get infected from hu-man source with S. aureus (0.480), but contact with sheep skin lesion risk estimation among sheep to get infected with MRSA was (0.263) time compare with risk estimate for sheep to get infected from human source with MRSA (0.222), those last numbers seem to be nearly to each other, which is highlight the confusing zoonotic issue, dose a man passes the infection to the livestock, or versus transmission targeting man life, [62] claimed that prolonged hospital staying, catheters, intravenous devices, skin lesions, wounds, ulcers, and receipt of antibiotics. Associated factors develop HA - MRSA infection, but the origin of LA-MRSA seems to be associated primarily with pigs that human-to-human transmission of LA-MRSA seems to be rare.

Contact with pets

In current study, although there was no significant correlation between contact with pets and infection with *S. aureus* or MRSA, sheep breeder who have contact with pets have (0.915) time for infection with S. aureus compare with those did not contact with pets (1.552) time. Sheep breeder who have contact with pets have (0.789) time for infec-tion with MRSA. Current results reflect that the pets represent one of the possible sources, but not the only one for probability transmission of S. aureus and MRSA.

Pets are a potential reservoir for human infection revealed correlation between close con-tact with humans and a higher risk of the colonized pet with *S. aureus* and harboring the antibiotic resistant determinants [63] the role of pets in transmission of *S. aureus* or MRSA even in low possibility reflect the fact that sheep breeders rarely treating those pets with antibiotics, although regular manner of most sheep breeders is owing one trained dog or more, sharing their daily trips to grazing sheep, guarding, protection, watching, and sometimes leading their flocks to a proper fields, those dogs fights and get scratches, injured, expose to external parasite, accidents in addition to swimming and licking the same water stream that used by sheep breeders and sheep, thus, it is

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undoubt-edly to be reservoir or carriers at least, if not get infected mostly with *S. aureus* ,but less with MRSA infections, two years later [64] in Poland found S. aureus infection rate among pets in door was (19.17%) higher than pets out door population (8.3%) describing a horizontal transfer of S. aureus isolates between humans, animals and the environment, In urban areas, [65]indicated; while pet industry is still in its early stage, has developed rapidly, recently, the number of dogs and cats has been increasing in developing coun-tries. Keeping pets is becoming a popular lifestyle all over the world, direct physical con-tact with pets occurs every day, thus possessing a potential risk of transmitting *S. aureus* between humans and pets may impact additionally on the use of antimicrobials in human medicine and therapy.

Sheep breeders practically one of the most in contact with their sheep on daily continuous basis companied many hours from dawn up to night, where they caring for, feeding, milk-ing, watering, cleaning, mow wool, take care of the hooves and horns, noting their health and Monitoring the seasons of mating, births, nursing and caring for their young lambs, depending on their families supporting, in various conditions of climate, heat, rain, wind, planting and harvest seasons, providing safe and appropriate shelters, cleaning the floors, fodder and Stripes, protecting them from wild animals and insects, thus it is obvious how deep is the relationship which makes the breeders eventually more responsible.

Conclusions

Methicillin resistant trait was common among *S.aureus* isolated from sheep breeders .MRSA infections correlated with age. Female sheep breeders were at high risk for get-ting S.aureus and MRSA infections. Sex , education level, economic status, contact with pet play no role in infection with S.aureus. hospitalization in last four weeks, contact with skin lesions correlated significantly with *S. aureus*, MRSA infections among breeders.

Recommendations

Increase health awarenss among sheep breeders' community for the significance of their role in dissemination of *S. aureus* to sheep and vice versa.

Source of funding: The current study was funded by our charges with no any other funding sources elsewhere.

Ethical clearance: This study conducted according to the principles of Helsinki declaration. A full explanation of the purpose of this study to all owners before starting. Dully filled consent form obtained from all owners who agree to participate in the study. Ap-proval of an ethical review committee of pathology department, college of veter-inary medicine, Diyala University, Iraq, taken before initiation into the work[14, 17-27].

Conflict of interest: Nil

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عوامل الخطر الاجتماعي الديموغرافي للعدوى الجلدية بالمكورات العنقودية الذهبية الحساسة والمقاومة للميثيسيلين بين مربي الأغنام في محافظة ديالى ، العراق

زينب برسيم فجر [١] ، علي ابراهيم علي العزي [٢]، احمد حنش الزهيري [٣]

الملخص

خلفية الدراسة: المكورات العنقودية الذهبية هي أحد مسببات الأمراض السائدة بين التهابات الجلد في الإنسان والحيوان.
اهداف الدراسة: لعزل وتحديد بكتيريا المكورات العنقودية الذهبية من مربي الأغنام بالطريقة التقليدية ونظام Vitek 2 الآلي ، الكشف عن الجين المقاوم للميثيسيلين (mecA) بواسطة PCR التقليدي. تقييم العلاقة بين عدوى بكتريا المكورة العنقودية البرتقالية وعوامل الخطر المحتملة في الإنسان (العمر ، الجنس ، المستوى التعليمي ، التمثال الاقتصادي ، الاستشفاء في الأسابيع الأربعة الماضية ملامسة آفات جلد الأغنام ، والتلامس مع الحيوانات الأليفة .
المرضى والطرائق: تم تسجيل ما مجموعه ٤٤ مقايضة جلدية تم جمعها من مربي الأغنام من مجموعة متنوعة من الآفات الجلدية المصابة (الجروح ، الخراجات ، التهاب الجلد التأتبي ، حب الشباب ، الأمراض الجلدية المزمنة ، إلخ) ؛ الجنس ، والعمر ، ومستوى التعليم ، والتمثال الاقتصادي ، والاستشفاء في الأسابيع الأربعة الماضية ، والتلامس مع آفات جلد الغنم ، والتواصل مع الحيوانات الأليفة للكشف عن بكتيريا المكورات العنقودية الذهبية الحساسة للميثيسيلين ، المكورات العنقودية الذهبية المقاومه للميثيسيلين وتقدير عوامل الخطر ، من خلال استخدام طرق المختبرات التقليدية بالإضافة إلى التوكيد. التقنيات بواسطة نظام VETEK2 و PCR ، باستخدام بادئات محددة (Staur 4، ٦) ، بادئات جينية mecA) MRSA).
النتائج: تم الإبلاغ عن المكورات العنقودية الذهبية الحساسة للميثيسيلين في ٣٤,٠٩٪ مقابل ٤٠٪ لجرثومة المكورات العنقودية الذهبية المقاومه للميثيسيلين بين مربي الأغنام. تم الإبلاغ عن ارتباط كبير بين الفئات العمرية وعدوى المكورات العنقودية الذهبية المقاومه للميثيسيلين. على الرغم من أن معدل الإصابة بالمكورات العنقودية الذهبية الحساسة للميثيسيلين والمكورات العنقودية الذهبية المقاومة للميثيسيلين كان أعلى بين الذكور مقارنة بالإناث ، لم يتم الإبلاغ عن أي ارتباط كبير بين الجنس والإصابة بالميثيسيلين العنقودية الذهبية والمكورات العنقودية الذهبية المقاومة للميثيسيلين. كانت المربين الإناث أكثر عرضة للإصابة بعدوى بكتيريا المكورات العنقودية الذهبية المقاومه للميثيسيلين مقارنة بالذكور. لا توجد علاقة ارتباط ذات دلالة إحصائية بين مستوى التعليم والوضع الاقتصادي والاتصال بالحيوانات الأليفة والميثيسيلين العنقودية الذهبية الحساسة وعدوى المكورات العنقودية الذهبية المقاومه للميثيسيلين كعوامل خطر. ارتبط إصابة المكورات العنقودية الذهبية الحساسة للميثيسيلين بين المربين ارتباطًا معنويًا بالاستشفاء في الأسابيع الأربعة الماضية. تم الإبلاغ عن ارتباط كبير بين التلامس مع الآفات الجلدية للأغنام والبكتريا العنقودية الذهبية الحساسة للميثيسيلين وعدوى المكورات العنقودية الذهبية المقاومه للميثيسيلين بين المربين.
الاستنتاجات: كانت الصفة المقاومة للميثيسيلين شائعة بين المكورات العنقودية الذهبية المعزولة من مربي الأغنام. ارتبطت عدوى المكورات العنقودية الذهبية المقاومه للميثيسيلين بالعمر. كان مربي الأغنام أكثر عرضة للإصابة بعدوى بكتريا المكورة العنقودية الذهبيه الحساسه والمكورات العنقودية الذهبية المقاومة للميثيسيلين. لا يلعب الجنس ، والمستوى التعليمي ، والوضع البيئي ، والاتصال بالحيوان الأليف أي دور في الإصابة ببكتيريا المكورات العنقودية الذهبية. يرتبط إدخال المريض للمستشفى للمعالجة في الأسابيع الأربعة الماضية ، والتلامس مع الآفات الجلدية للاغنام بشكل كبير مع الاصابه ب المكورات العنقودية الذهبية الحساسة للميثيسيلين و المكورات العنقودية الذهبية المقاومه للميثيسيلين بين المربين.

الكلمات المفتاحية: المكورات العنقودية الذهبية ، الجلد ، مربي الأغنام ، عوامل الخطر

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