ORIGINAL ARTICLE

Evaluation of serum prolactin level in psoriasis vulgaris

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ABSTRACT

Background: Prolactin may paly a role in pathophysiology of psoriasis.

Material and Methods: This study included 100 patients with plaque-type psoriasis 60(60%) males and 40(40%) females. The controls group comprised 100 healthy, age and sex matched persons. In the patients and controls groups, age ranged from 20 to 50 years. All selected patients presented with chronic plaque psoriasis located on different sites. The duration of disease ranged from 1 to 36 months with a mean of 13.60 ± 8.03. The patients were classified as mild, moderate and severe, according to PASI score. There were 70(70%) mild, 16(16%) moderate and 14(14%) severe. Serum prolactin levels were measured for patients and controls by ELISA method.

Results: Prolactin levels were higher in female patients than in males. Statistical analysis revealed a positive correlation between sex of patients and the serum levels of PRL (P value < 0.05). There was a positive correlation between PRL levels and the severity of psoriasis (PASI score) (P value < 0.05). Study also revealed a positive correlation between the duration of psoriasis and the serum levels of PRL (P value < 0.05).

Conclusion: Serum prolactin can be considered as marker for disease activity and duration in psoriatic patients. In addition, prolactin seems to have a role in pathogenesis of psoriasis.

INTRODUCTION

Psoriasis is a chronic inflammatory skin disease characterized by hyperproliferation of keratinocytes and accumulation of T cells in the epidermis and dermis of psoriatic lesions, affecting approximately 1-3% of population. Environmental, genetic, and immunologic factors appear to play a role in psoriasis.[1]

Prolactin (PRL) is a hormone synthesized and secreted by lactotroph cells in the anterior pituitary gland. There is also extrapituitary hormone secretion by many cells, including cells of the immune system. In physiological conditions PRL is responsible for lactogenesis and other processes associated with it. Prolactin plays a significant role during the immune response as a cytokine, affecting proliferation and differentiation of many immune cells. The biological effect of the hormone depends on binding with the specific prolactin receptor PRL-R, and activation of the transcription factors of targeted genes.[2]

Prolactin (PRL), have an important role in modulating the immune response.[3] It also has proliferative effects on human keratinocytes, a dominant feature of psoriasis and it is thought that this hormone may play a role in the pathogenesis of the disease.[4]

The aim of this study was to evaluate serum prolactin level in psoriasis vulgaris patients, and its relation to PASI score and compare it with the age and sex matched healthy controls.

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MATERIAL AND METHODS

This comparative case-control study was conducted in the department of Dermatology, Venereology and Andrology, Al-Azhar University Hospitals in collaboration with the department of clinical pathology over a period of 1 year from September 2015 to September 2016. Informed written consent was obtained from all the participants in the study after explaining the nature of the study to them.

One hundred patients with plaque-type psoriasis, 60 men and 40 women were enrolled in the study. At the time of enrollment in the study, none of the patients had received any topical or systemic treatment for at least 4 weeks. The control group comprised 100 healthy volunteers, 60 male and 40 female. The controls had no history of any skin abnormalities or any chronic-debilitating disease.

Diagnosis of psoriasis was based on clinical findings and histopathogical studies. A complete clinical history was taken and dermatological examination was done for each patient to determine the extent, duration and distribution of the disease.

The exclusion criteria included patients who suffered from prolactinoma, thyroid disease, acromegaly, renal failure, hepatic failure, seizures, and central nervous system tumors. Also, pregnant or lactating females were excluded. Patients on antipsychotics and antidepressants (including dopaminergic receptor blockers and dopamine synthesis inhibitors) were also excluded. In addition, any patient, who had used any of the following drugs: opioids, cimetidine, ranitidine, verapamil, or estrogens, at or about the time of performing the laboratory tests, was excluded. All patients and controls who were smokers were also excluded from this study.

Clinical severity of psoriasis was assessed by using the psoriasis area severity index (PASI) score according to Naldi and Gambini,[5] Malkic et al.[6]

A clinical scoring system is a system translating a "clinical judgment" into a scale. PASI score was adopted and done for all patients as an indication of degree of severity. PASI contain 4 items: surface area, severity of erythema (redness), induration (thickness), and desquamation (scale) evaluated for 4 body areas (head, trunk, and upper and lower extremities). The four main anatomic sites are assessed: the head (h), upper extremities (u), trunk (t) and lower extremities (l) roughly corresponding to 10%, 20%, 30% and 40% of body surface area, respectively.

The PASI score is calculated from: PASI=0.1 (Eh + Ih + Dh) Ah + 0.2 (Eu + Iu + Du) Au + 0.3 (Et + It + Dt) At + 0.4 (El + Il + Dl) Al, where E=erythema, I=induration, D=desquamation and A=area. E, I, and D are assessed according to a 4-point scale where 0=no symptoms, 1=slight, 2=moderate, 3= marked, and 4=very marked. A is assigned a numerical value based on the extent of lesions in a given anatomical site: 1 (<10%); 2 (10-29%); 3 (30-49%); 4 (50-69%); 5 (70-89%); 6 (90- 100%).

The PASI varies in steps of 0.1 units from 0.0 to 72.0. The highest score represents complete erythroderma of the severest possible degree. Psoriasis was graded according to the PASI score, presenting at the time of blood collection. The patients were divided into three groups based on the severity of the disease as mild (PASI <3), moderate (PASI 3.1-10) and severe (PASI >10).

SEROLOGICAL EVALUATION

Serum sample collection and storage: Blood samples were taken in the morning between 8.00 and 10.00 A.M from both patients and controls, keeping in mind the circadian variation of PRL secretion. In women, measurements were taken in the premenstrual phase of the cycle. 5 ml of venous blood, ws obtained from every patient and control using a wide-bore syringe to avoid hemolysis of the red blood corpuscles, and was kept protected from light, allowed to clot completely (within 30-60 minutes) at the room temperature. Centrifugation was done at 5,000 rpm for 5-10 minutes to separate the serum. Serum was separated and stored at -20 °C until analyzed.

Prolactin assay was done by ELISA (Monobid Inc. Lake Forest. Ca 92630, USA): Sample and a biotinylated monoclonal prolactin-specific antibody form a first complex. After addition of a monoclonal prolactin-specific antibody labeled with a ruthenium complex and streptavidin-coated microparticles, a-sandwich complex is formed and becomes bound to the solid phase via interaction of biotin and streptavidin. Results were determined via a calibration curve which is instrument-specifically generated by 2-point calibration and a master curve provided via the reagent barcode. Reference range for PRL was 2-18 ng/ml for males and 2-29 ng/ml for females.

STATISTICAL ANALYSIS

Statistical analysis of the data was performed by using Statistical Package for Social Sciences (SPSS Version 17). Statistical significance of the results was carried out by the Chi-square test and the independent samples t-test. Statistical significance was determined at a level of $P < 0.05$.

RESULTS

This study included 100 patients and 100 controls. In the patients group, there were 60 males (60%) and 40 females (40%). While, in the control group, there were 60 males (60%) and 40 females (40%). There was no significant difference in sex between patients and controls groups, the P value was found to be >0.05 [Table 1].

In the patients and controls groups, age ranged from 20 to 50 years, with a mean of 34.31 ± 9.39 years for patients group. While, in the control group, the mean age was 34.91 ± 9.05 years. There was no significant difference in age between patients and controls groups, the P value was found to be > 0.05 [Table 1].

Table 1 Demographic data of patients and controls

		Control group	Cases group	Chi-square test	
		No.= 100	No.= 100	X^2/t*	P-value
Sex	Female	40 (40.0%)	40 (40.0%)	11.538	0.001
	Male	60 (60.0%)	60 (60.0%)		
Age	Mean±SD	34.91±9.05	34.31±9.39	0.460*	0.646
	Range	20 – 50	20 – 50		
	Range	1.6 – 14.1	3.5 – 29		

All selected patients presented with chronic plaque psoriasis located on different sites. The duration of disease ranged from 1 to 36 months with a mean of 13.60 ± 8.03 [Table 2].

According to PASI score, patients were classified into mild, moderate and severe cases. They were 70 (70%) mild, 16 (16%) moderate and 14 (14%) severe [Table 2], [Fig. 1].

Serum PRL levels in the patients group ranged from 3.5 to 29 ng/ml, with a mean of 12.41 ±

Table 2 Disease duration and severity among the studied patients

Disease duration/months	Mean ± SD	13.60 ± 8.03
	Range	1 – 36
PASI Score	Mean ± SD	9.58 ± 7.91
	Range	0.6 – 32
Psoriasis Severity	Mild	70 (70.0%)
	Moderate	16 (16.0%)
	Severe	14 (14.0%)

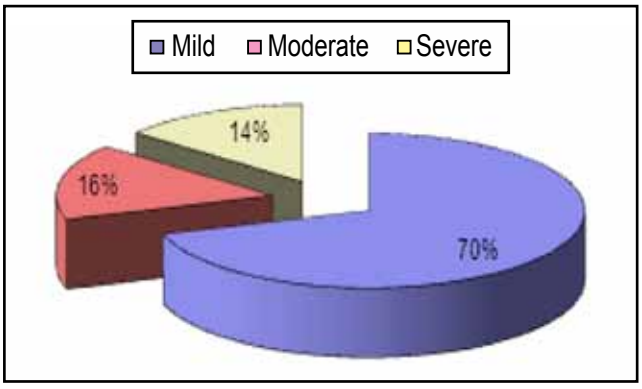

Fig. 1 Diagram showing classification of patient according to PASI score.

6.05 ng/ml. In the control group, serum PRL levels ranged from 1.6 to 14.1 ng/ml, with a mean of 5.53 ± 2.97 ng/ml. Thus, serum PRL levels were higher in patients than in controls and the difference was statistically significant (P value < 0.05) [Table3], [Fig. 2].

In this study, PASI score in the patients ranged from 0.6 to 32 with a mean value of 9.58 ± 7.91

Table 3 Comparison of serum prolactin level between patients and control groups

Prolactin Hormone	Control	Cases	Independent t-test	
	No.=100	No.=100	T	P-value
Mean±SD	5.53±2.97	12.41±6.05	-10.204	0.000
Range	1.6 – 14.1	3.5 – 29		

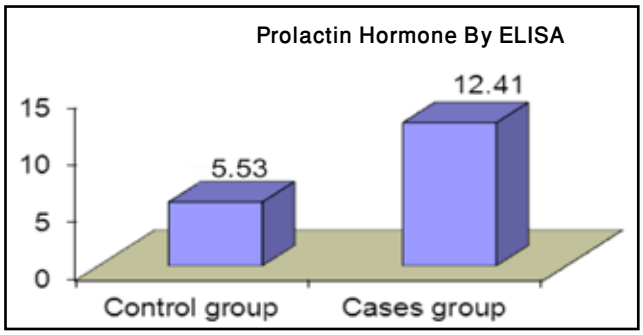

Fig. 2 Diagram showing serum prolactin level in patients and controls groups.

[Table 2]. PRL levels were higher in severe cases of psoriasis, than in mild and moderate cases. Thus, there was a positive correlation between PRL levels and the severity of psoriasis (P value < 0.05) [Table 4, 5], [Fig. 3, 4].

The duration of disease among the patient ranged from 1 to 36 months with a mean of 13.60 ±

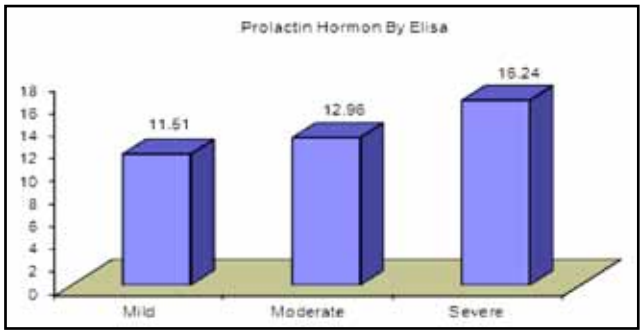

Fig. 3 Diagram showing correlation between severity and prolactin hormone levels.

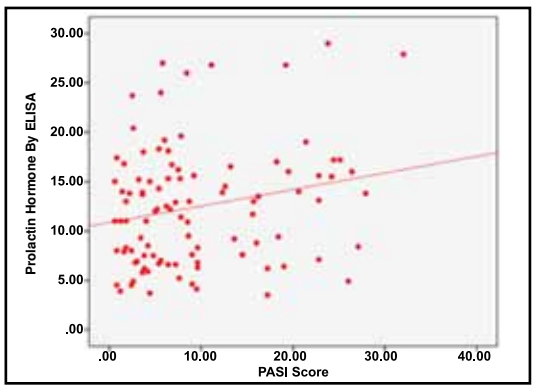

Fig. 4 Scatter plot showing the correlation between prolactin hormone levels and PASI score.

Table 4 Relation between severity and prolactin hormone levels

Prolactin Hormone By Elisa	Mild	Moderate	Severe	Chi-square test	
	No.= 70	No.= 16	No.=14	X²/F*	P-value
Mean±SD	11.51±5.64	12.96±6.72	16.24±6.09	3.849*	0.025
Range	3.7 – 27	3.5 – 26.8	7.1 – 29		

8.03 [Table 2]. A Statistical analysis revealed a positive correlation between the duration of psoriasis and the serum levels of PRL (P value < 0.05) [Table 5].

The range of age amongst the patients was found to be 20 years to 50 years, with a mean of 34.31

Table 5 Correlation of prolactin hormone levels with age, disease duration and PASI score

	Prolactin Hormone By ELISA	
	R	**P-value**
Age	0.170	0.091
Disease duration/months	0.249*	0.012
PASI Score	0.218*	0.030

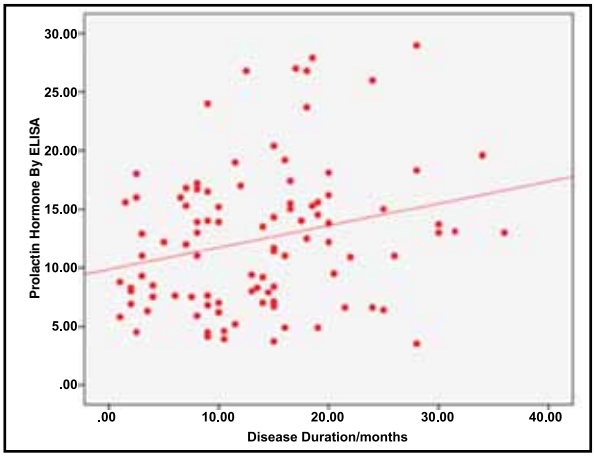

Fig. 5 Scatter plot showing correlation between prolactin hormone levels and duration of disease.

± 9.39. Statistical analysis revealed a negative correlation between age of patient and the serum levels of PRL (P value: 0.091) [Table 5].

Regarding sex, the range of prolactin levels among male patients was found to be 3.5 to 19.2 ng/ml with a mean of 9.79 ± 4.37 ng/ml. While, prolactin levels among female patients ranged from 6.9 to 29 ng/ml with a mean of 16.32 ± 6.13. Thus, prolactin levels were higher in female patients than in male patient. Statistical analysis revealed a positive correlation between sex of patients and the serum levels of PRL (P value < 0.05) [Table 6].

Table 6 The correlation between Prolactin levels and sex

		Prolactin Hormone By ELISA		Independent t-test	
		Mean ± SD	**Range**	**t/F***	**P-value**
Sex	Female	16.32 ± 6.13	6.9 – 29	6.216	0.000
	Male	9.79 ± 4.37	3.5 – 19.2		

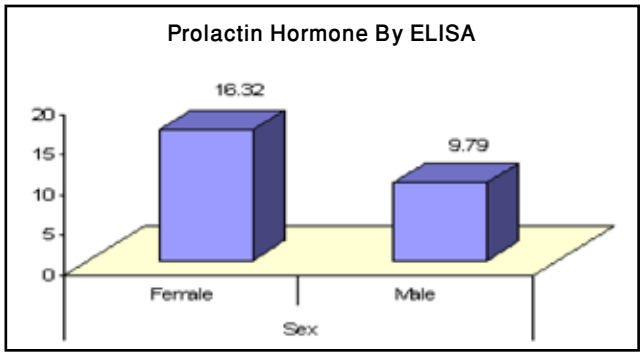

Fig. 6 Diagram showing the correlation between prolactin levels and sex of patients.

DISCUSSION

Psoriasis is a chronic inflammatory skin disease affecting approximately 1-3% of population.[1,7] The diagnosis of psoriasis is mainly based on its clinical presentation. It is characterized by well-defined red, scaly plaques typically located on the scalp, knee, or elbows.[8] The main pathological features of these skin lesions are keratinocyte hyperproliferation, loss of differentiation, inflammatory cell infiltration, and vascular changes.[9,10]

Pathogenesis of psoriasis includes genetic factors, T cells mediated immunity, several environmental factors, such as injury, infection, stress and drugs.[11,12] In addition, it has been reported that some hormones may also have a role in the pathogenesis of psoriasis, due to their effects on keratinocyte proliferation.[13, 14]

Prolactin, is a neuropeptide hormone secreted by

the anterior pituitary gland, it can also be produced by extra-pituitary sites. Expression of prolactin and prolactin receptor has been demonstrated in several cutaneous cell population, including keratinocytes, fibroblasts, sweat glands and sebaceous glands.[15,16] There are some reports suggesting that prolactin may modulate skin immune system and that it may be involved in the pathogenesis of psoriasis.[17,18,19]

Psoriasis may worsen postpartum, reflecting the physiological hyperprolactinemia associated with lactation.[20] Bromocriptine, the potent dopaminergic inhibitor of pituitary prolactin secretion, induced remission of psoriatic lesions.[21] Psoriasis was aggravated in patients with prolactinoma. And, on treatment with bromocriptine, the psoriatic lesions improved. Interestingly, the discontinuation of bromocriptine resulted in a relapse of psoriasis.[22, 23, 24]

Nevertheless, in view of the recognized increase of human serum PRL levels upon psychoemotional stress[25] and the exacerbating effect of psychological stress in patients with psoriasis vulgaris. It would be interesting to examine the effects of psychological stress on pituitary PRL production correlated with clinical features in patients with psoriasis vulgaris versus healthy controls.[26]

Serum PRL levels might represent a marker of inflammatory joint disease in patients suffering from psoriasis vulgaris.[24]

This study was aimed to study the possible role of PRL in the pathogenesis of psoriasis and its correlation with the disease activity and duration. Serum level of PRL was higher in psoriatic patients than controls and the difference was statistically significant ($P < 0.05$). Also, this study revealed a positive correlation between serum PRL levels and PASI score. In addition, the current study showed a positive correlation between serum PRL level and duration of disease. These results were consistent with previous studies.[13] These results indicate that serum prolactin may play a role in pathogenesis of psoriasis and can be considered as a marker for disease activity and duration.

In a study performed by Dilme-carreras et al.[19] that included 20 patients of psoriasis and 20 healthy controls, PRL levels were measured in serum of psoriatic patients before and after treatment with tacalcitol ointment and disease severity was assessed by PASI in all patients. Serum levels of PRL were found to be significantly higher in patients than controls before treatment. They also found that PRL levels were significantly reduced after treatment with tacalcitol and there was a correlation between pretreatment serum PRL levels and PASI score.

Shalaby et al,[27] carried out a study on 50 patients of psoriasis before and after treatment with NB-UVB. They found that, serum levels of PRL were found to be significantly higher in patients before treatment. They also found that PRL levels were significantly reduced after treatment with NB-UVB, but there was no correlation between serum PRL levels and PASI score.

In a study of kato et al[28] that included 30 patients with psoriasis before and after 4 weeks of treatment with methotrexate for detection of serum PRL levels by ELISA, while serum sample were taken from controls subjects for comparison. Serum prolactin levels were statistically significant among patients compared to controls, with significant decrease among patients after treatment. A significant positive correlation was found between serum PRL levels

and PASI score before and after treatment.

In a study conducted by El-Khateeb et al,[29] that comprised of 15 psoriasis patients and 15 controls, PASI score was evaluated, and PRL levels in serum were assessed. They found that PRL levels were significantly elevated in psoriatic lesional skin. They also noted a positive correlation of serum PRL level between lesional and non-lesional skin in psoriasis and between serum and clinically normal skin in both psoriasis and control subjects.

In 1987, one study that included 35 patients with psoriatic arthritis refractory to conventional therapy were treated with bromocriptine. Significant improvement was seen in 77%, with 34% showing complete remission and 43% with 50% improvement in articular symptoms.[30] Therapeutic trials with bromocriptine should be carried out in psoriatic patients to explore its effect, especially in severe cases.

It is obvious that, in previous studies outlined, the number of cases was relatively few. So, further studies with larger number of patients are needed to confirm or refute each of these results. Some authors have suggested a local source of prolactin or a prolactin like substance that may induce or exacerbate psoriatic lesions which may be independent from the pituitary sources of prolactin.[31] Moreover, fuctional PRL receptors are detected on epidermal keratinocytes, indicating that PRL may be involved in the hyperproliferation of keratinocytes in psoriasis.[29] In a study demonstrating the synthesis and release of prolactin from dermal fibroblasts *in vitro*, a potential local source of prolactin in the skin was suggested. It was also suggested that decidual fibroblast cells also express prolactin.[32] Prolactin is a member of the type I cytokine superfamily and shows a variety of immunoregulatory effects.[15] It is involved in the proliferation of lymphocytes during immune responses.[33,34] It enhances proliferation of interferon-c (IFN-c) production in T cells or NK (natural killer) cells[35] and potentiates IFN-c-induced CXC chemokine production in keratinocytes. Which, in turn, generates abundant infiltrates of type I T cells.[17] It stimulates the hyperproliferation of keratinocytes and induces angiogenesis through the production of vascular endothelial growth factor (VEGF).[36] Prolactin induces CCL20 secretion from epidermal keratinocytes in psoriatic lesions, which recruit Th17 cells that release interleukin-17 (IL-17). Prolactin and IL-17 cooperate in a positive feedback loop to increase CCL20 secretion. This process may aggravate the Th17-mediated inflammation in psoriatic lesions. It stimulates antigen-presenting cells by increasing the expression of major histocompatibility complex (MHC) class II or co-stimulatory molecules, CD40, B7-1, or B7-2.[37] It acts cooperatively with granulocyte-macrophage colony stimulating factor (GMCSF) to promote differentiation of peripheral blood monocytes into dendritic cells (DCs) *in vitro* and to enhance the effectiveness of antigen presentation by DCs.[38] It is obvious that prolactin may influence the pathogenesis of psoriasis at several levels.[39]

Priestley et al.[40] in their study did not find any significant difference in PRL and growth hormone levels between patients and controls. Also, Gorpelioglu et al.[41] in their study estimated PRL levels in 39 patients with psoriasis and compared these levels with 36 control subjects. Nine patients and five controls had slightly increased PRL levels but below 100 ng/ml. In their study,

they could not find any statistically significant difference in serum PRL levels between patients and controls. Also, their study did not reveal any statistical correlation between the PASI score of patients and their PRL levels. In another study by Handjani et al.,[4] they measured the levels of PRL and other hormones in blood and synovial fluid in seven patients with arthritis of the knee associated with psoriasis and they reported that there were no significant differences between patient and control groups. These findings were not consistent with the results of the present study. These findings can be explained by the relatively small sample size, which means additional studies with large number of patients are required to confirm or refute each of these findings.

This study found an association between serum PRL levels and psoriasis. Also, the present study revealed an association between PRL levels and severity of the disease. In addition, the current study showed an association between PRL levels and duration of the disease. The findings of this study lead to assumption that prolactin may serve as a marker for disease activity and duration in psoriatic patients. According to the results of this study prolactin seems to have a role in pathogenesis of psoriasis. However, studies with large sample sizes are still necessary in order to confirm or refute the results of this study and to clarify the role prolactin in the etiopathogenesis of psoriasis. Further controlled therapeutic trials of bromocriptine should be carried out in psoriatic patients especially in severe cases, even if prolactin levels are normal. Further research should be done in the future for development of specific treatment by using of antibodies against prolactin.

CONCLUSION

On the basis of findings of this study, it can be concluded that the serum prolactin can be considered as marker for disease activity and duration in psoriatic patients. In addition, prolactin seems to have a role in pathogenesis of psoriasis.

REFERENCES

1. Al Robaee AA (2010): Molecular genetics of Psoriasis (Principles, technology, gene location, genetic polymorphism and gene expression), International Journal of Health Sciences; 4(2):103-27.
2. Kokot I, Pawlik-Sobecka L, Płaczkowska S and Piwowar A (2013): Prolactin as an immunomodulatory factor in psoriatic arthritis. Postepy higieny i medycyny doswiadczalnej (Online); 67:1265-72.
3. Shelly S, Boaz M and Orbach H (2012): Prolactin and autoimmunity. Autoimmun Rev.; (6-7):A465-70.
4. Handjani F, Saki N, Ahrari I, Ebrahimi M, Khorrami MM and Nematollahi P (2014): Serum prolactin levels in psoriasis vulgaris. ISRN Dermatol; 586049.
5. Naldi L and Gambini D (2007): The clinical spectrum of psoriasis. Clin Dermatol; 25:510-18.
6. Malkic SE, Hadzigrahic N and Cickusic AJ (2015): Psoriasis and metabolic syndrome. Med Arch; 69:85-87.
7. Bowcock AM (2005): The genetics of psoriasis and autoimmunity. Annu. Rev. Genomics Hum. Genet; 6: 93-122.
8. Elder JT, Bruce AT, Gudjonsson JE et al. (2010): Molecular dissection of psoriasis: integrating genetics and biology, Journal of Investigative Dermatology; 130 (5): 1213-26.
9. Wahl AK, Robinson HS, Langeland E, Larsen MH, Krogstad AL and Moum T (2013): Clinical characteristics associated with illness perception in psoriasis, Acta Dermato-Venereologica; 94 (3):271-75.
10. Keshavarz E, Roknsharifi S, Shirali MR and Roknsharifi M (2013): Clinical features and severity of psoriasis:a comparison of facial and nonfacial involvement in Iran," Archives of Iranian Medicine; 16 (1): 25-28.

11. Bowcock AM and Barker JN (2003): Genetics of psoriasis, the potential impact on new therapies. J Am Acad Dermatol; 49:51-56.
12. Ozawa M and Aiba S (2004): immunopathogenesis of psoriasis. Curr Drug Targets Inflamm Allergy; 3:137-44.
13. Giasuddin ASM, El-Sherif AI and El-Ojali SI (1998): Prolactin: does it have a role in the pathogenesis of psoriasis? Dermatology; 197:119-22.
14. Robati RM, Toossi P, Rahmati-Roodsari M, Khalilazar S, Abolhasani E, Namazi N and Younespour S (2013): Association of psoriasis severity with serum prolactin, thyroid hormones and cortisol before and after treatment. Scientific World Journal. Published online Oct 28.
15. Ben-Jonathan N, Mershon JL, Allen DL and Steinmetz RW (1996): Extrapituitary prolactin; distribution, regulation, functions and clinical aspects. Endocr Rev; 17:639-69.
16. Foitzik K, Langan EA and Paus R (2009): Prolactin and the skin: a dermatological perspective on an ancient pleiotropic peptide hormone. J Invest Dermatol; 129:1071-87.
17. Kanda N and Watanabe S (2007): Prolactin enhances interferongamma-induced production of CXC ligand 9 (CXCL9), CXCL10 and CXCL11 in human keratinocytes.Endocrinology; 148:2317-25.
18. Azizzadeh M, Malek M, Amiri M and Ghorbani R (2009): Does prolactin indicate severity of psoriasis? Iranian J Dermatol; 12:79-81.
19. Dilme-Carreras E, Martín-Ezquerra G, Sanchez-Regana M and Umbert-Millet P (2011): Serum prolactin levels in psoriasis and correlation with cutaneous disease activity; Clin Exp Dermatol; 36:29-32.
20. Damasiewicz-Bodzek A and Kos-Kudła B (2007): Hormonal factors in etiopathogenesis of psoriasis. Pol Merkur Lekarski 2007; 22:75-78.
21. Weber G, Neidhardt M, Frey H, et al. (1981): Treatment of psoriasis with bromocriptin. Arch Dermatol Res; 271:437-39.
22. Valentino A, Fimiani M, Bilenchi R, et al. (1984): Therapy with bromocriptine and behavior of various hormones in psoriasis patients. Boll Soc Ital Biol Sper; 60:1841-44.
23. Sánchez-Regaña M and Umbert MP (2000): Psoriasis in association with prolactinoma: three cases. Br J Dermatol; 143:864-67.
24. Husakova M, Lippert J, Stolfa J, Sedova L, Arenberger P, Lacinova Z and Pavelka K (2015): Elevated serum prolactin levels as a marker of inflammatory arthritis in psoriasis vulgaris. Biomedical papers; 159 (4):562-68.
25. Jezova D, Vigas M, Hlavacova N and Kukumberg P (2010): Attenuated neuroendocrine response to hypoglycemic stress in patients with panic disorder. Neuroendocrinology; 92 (2):112-19.
26. Langan EA, Ramot Y, Goffin V, Griffiths CE, Foitzik K and Paus R (2010): Mind the (Gender) Gap: Does Prolactin Exert Gender and/or Site-Specific Effects on the Human Hair Follicle&quest. Journal of Investigative Dermatology; 130 (3):886-91.
27. Shalaby ME, Hassan HM, Aref MI and Ebeid AD (2015): Serum Prolactin and ImmunoglobulinE Levels in Psoriasis Vulgaris before and after NB-UVB Therapy. Med chem; 5:432-36.
28. Kato AM, Gheida SF, Elbendary AS, A Badawy AA, El-Fakharany RE (2012): Serum level of prolactin in psoriatic patients, Egyptian Dermatology online Journal; 8 (2):1.
29. El-Khateeb EA, Zuel-Fakkar NM, Eid SM and Abdul-Wahab SE (2011): Prolactin level is significantly elevated in lesional skin of patients with psoriasis. Int J Dermatol; 50:693-96.
30. Weber G and Frey H (1987): Treatment of psoriatic arthritis with bromocriptine. J Am Acad Dermatol; 16:388-89.
31. Kooijman R, Gerlo S, Coppens A and Hooghe-Peters EL (2000): Growth hormone and prolactin expression in the immune system, Annals of the New York Academy of Sciences; 917:534-40.
32. Richards RG and Hartman SM (1996): Human dermal fibroblast cells express prolactin in vitro, Journal of Investigative Dermatology; 106 (6):1250-55.
33. Pellegrini I, Lebrun JJ, Ali S and Kelly PA (1992): Expression of prolactin and its receptor in human lymphoid cells. Mol Endocrinol; 6:1023-31.
34. Matera L (1996): Endocrine, paracrine and autocrine actions of prolactin on immune cells. Life Sci; 59:599-614.
35. Matera L and Mori M (2000): Cooperation of pitu-

itary hormone prolactin with interleukin-2 and interleukin-12 on production of interferon-gamma by natural killer and T cells. Ann N Y Acad Sci; 917:505-13.

36. Girolomoni G, Phillips JT and Bergstresser PR (1993): Prolactin stimulates proliferation of cultured human keratinocytes.J Invest Dermatol; 101:275-79.
37. Kanda N, Shibata S, Tada Y, Nashiro K, Tamaki K and Watanabe S (2009): Prolactin enhances basal and IL-17-induced CCL20 production by human keratinocytes. Eur J Immunol; 39:996-1006.
38. De Bellis A, Bizzarro A, Pivonello R, Lombardi G and Bellastella A (2005): Prolactin and autoimmunity. Pituitary; 8:25-30.
39. Matera L, Bellone G, Lebren JJ, Hooghe Peters EL, Di Celle PF, Foa R, et al. (2006): Role of prolactin in the in vitro development of interleukin-2-driven anti-tumoural lymphokine-activated killer cells. Immunology; 89:619-26.
40. Priestley GC, Gawkrodger DJ, Seth J, Going SM and Hunter JA (1984): Growth hormone level in psoriasis. Arch Dermatol Res; 276:147-50.
41. Gorpelioglu C, Gungor E and Alli N (2008): Is prolactin involved in etiopathogenesis of psoriasis? J Eur Acad Dermatol Venereol; 22:1135-36.