



普通高等教育“十三五”规划教材  
全国高等医药院校规划教材

英文原版改编版

# Medical Immunology

# 医学免疫学

留学生与双语教学用

*Textbook of Immunology* (second edition)

[印度] 苏尼尔·库马尔·莫汉蒂 [印度] K. 赛·利拉 著

Sunil Kumar Mohanty K Sai Leela Original Editors

姚 智 主编

YAO Zhi Chief Editor of Adaptation Edition

清华大学出版社



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北 京

## 内 容 简 介

医学免疫学是一门独立的学科,是研究免疫系统的组织结构和功能的科学。它从不同的角度和水平来揭示免疫系统识别并消除抗原性异物的应答过程和规律,并应用这些规律来阐明免疫相关疾病发生发展的机制,达到防治相关疾病的目的。医学免疫学进展迅速,知识量大,本教材基于最基本的理论和知识,介绍了抗原、免疫器官和免疫细胞、免疫分子(抗体、补体、细胞因子、黏附分子和MHC等)、免疫应答、免疫预防、免疫治疗、免疫诊断、免疫耐受、免疫相关疾病以及感染免疫等。

本教材适用于医学专业外国留学生的医学免疫学英文教学和本科双语教学。

Sunil Kumar Mohanty, K Sai Leela

Textbook of Immunology (second edition)

9789350904749

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Originally published in India by Jaypee Brothers Medical Publishers (P) Ltd.

English language adaptation rights arranged with Jaypee Brothers Medical Publishers (P) Ltd. through McGraw-Hill Education (Asia)

北京市版权局著作权合同登记号 图字:01-2015-5506

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### 图书在版编目(CIP)数据

医学免疫学=Medical Immunology:英文原版改编版:留学生与双语教学用:英文/(印)苏尼尔·库马尔·莫汉蒂,(印)K.赛·利拉著;姚智主编. —北京:清华大学出版社,2017  
(普通高等教育“十三五”规划教材 全国高等医药院校规划教材)  
ISBN 978-7-302-46308-5

I. ①医… II. ①苏… ②K… ③姚… III. ①医学—免疫学—医学院校—教材—英文 IV. ①R392

中国版本图书馆CIP数据核字(2017)第021399号

责任编辑:李 君 王 华

封面设计:戴国印

责任校对:刘玉霞

责任印制:杨 艳

出版发行:清华大学出版社

网 址: <http://www.tup.com.cn>, <http://www.wqbook.com>

地 址:北京清华大学学研大厦A座 邮 编:100084

社 总 机:010-62770175

邮 购:010-62786544

投稿与读者服务:010-62776969, [c-service@tup.tsinghua.edu.cn](mailto:c-service@tup.tsinghua.edu.cn)

质量反馈:010-62772015, [zhiliang@tup.tsinghua.edu.cn](mailto:zhiliang@tup.tsinghua.edu.cn)

印 装 者:北京亿浓世纪彩色印刷有限公司

经 销:全国新华书店

开 本:185mm×260mm

印 张:13.75

字 数:517千字

版 次:2017年2月第1版

印 次:2017年2月第1次印刷

印 数:1~3000

定 价:99.80元

产品编号:065889-01

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## 注 意

由于医学科技的发展,该领域的理论知识和临床实践在不断变化。随着新的研究与经验不断扩充我们的知识结构,在实践、治疗和用药方面做出适当的调整是必要或适宜的。建议读者检查相关操作的最新信息,或检查每一用药生产厂家所提供的最新产品信息,在临床执业医师的指导下确定药物的推荐剂量、服用方法、服用时间以及相关禁忌证。经治医师根据对患者的了解和相关经验,确立诊断,确定每一位患者的服药剂量和最佳治疗方法,并采取适当的安全预防措施,是其职责所在。不论是出版商还是著作者,对于在本出版物使用过程中出现的任何个人损伤和(或)财产损失,均不承担任何责任。

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# General Foreword

## 总序言

随着中国政治、经济、文化的快速发展，中国软实力和国际影响力的不断提升，“留学中国计划”的逐步实施，越来越多的外国人认识到留学中国的未来价值，来华留学生规模不断扩大。2013 年，有来自 200 个国家和地区的 346 499 名外国留学生在我国 746 所高等院校和科研机构学习或进修，我国已经成为亚洲最大的留学目的地国家。

近年来，来华学习医学的留学生人数增长尤为迅猛，目前来华学习医学的留学学历生人数已位居来华留学学历生人数的首位，2013 年占比高达 21.76%，为 29 048 名。

为了维护我国高等教育的国际声誉，教育部高度重视来华医学留学生教育教学质量，不断加强对医学留学生教育教学的规范和管理，多种措施付诸实施。2007 年教育部即制定了《来华留学生医学本科教育（英语授课）质量控制标准暂行规定》，要求招生院校严格落实执行。2013 年 7 月，教育部国际合作与交流司下达了《关于对招收本科临床医学专业（英语授课）来华留学生的高等学校进行专项检查的通知》，委托中国高等教育学会外国留学生教育管理分会组成专家组对招生院校进行专项检查。2013 年 8 月，全国性的“来华留学生（医学）教学专业委员会”成立大会暨第一次学术研讨会在天津医科大学成功召开。2014 年上半年，教育部国际合作与交流司又组织专家组对部分医学院校实施了飞行检查。2014 年 6 月，“来华留学医学教育 2014 学术研讨会暨首届医学院校国际教育学院院长论坛”在安徽医科大学举办。

来华留学生的教学质量是来华留学教育事业可持续发展的核心保障，来华留学生教育的教材建设是保障和提升教学质量非常重要的手段。适合来华医学留学生使用的教材的需求越来越迫切，临床医学专业的教材长期匮乏和不足，教材编写、教材内容、教材形式、教材版权等都需要进行整合和改进完善。

在教育部国际合作与交流司的指导和中国高等教育学会外国留学生教育管理分会的支持下，众多医学院校的领导和专家经过多次讨论、磋商，决定成立“来华医学留学生教育教材建设专家指导委员会”，委托天津医科大学和清华大学出版社共同承担全国性临床医学专业英文版立体化教材编写和出版的具体组织工作。

天津医科大学有近 17 年的英语授课培养外国留学生的历史，在来华医学留学生教育的实践方面开始较早，是教育部指定的第一批计划招生全英文临床医学专业的 30 余所院校之一，也是教育部首批批准的“来华留学教育示范基地”，设有教育部来华留学英语教学师资培训中心（医学），至今已举办 6 期培训班，为全国 52 所医学院校培训英语授课教师 364 人，所编教材在全国 30 余所西医院校教学中被借鉴或使用，在全国医学高等院校来华留学生教育教学

领域里具有代表性和很大的影响力。

清华大学出版社在高等教育综合出版领域里，排名我国第二位，是以出版全方位、多学科、立体化的高等教育教材为主的大社；上级主管单位为教育部，主办单位是清华大学，高质量、创新型、探究型的特色教材是其出版的重点任务，也是其肩负的社会职责所在，其所具有的强烈的社会责任感、主动性和积极性值得肯定。

据悉，该套教材近 50 种，主要供临床医学留学生、七年制或八年制医学生、医学本科生英语或双语教学使用。部分教材由我国长期从事医学留学生教育的教授、学者编写，其余大部分教材由清华大学出版社从多家国外出版社引进，改编出版，以适应我国临床医学专业留学生课堂教学和临床实习所需。

该套教材的陆续出版，是我国对高校来华留学生教育教材系列化、专门化的首次探索。希冀其会对全面提升来华医学留学生教育质量水平，对规范来华医学留学生教育的教材建设，甚至对其他学科的留学生教材建设，起到积极的示范效应和引领性作用。

这是一个良好的开端，希望该套教材在今后教学中经过不断探索、不断总结，得到修订，日臻完善。

中国高等教育学会外国留学生教育管理分会

副会长兼秘书长



2014 年 10 月

# Preface

## 前言

Immunology is the study focusing on the organizational structures and functions of immune system. It demonstrates remarkable features of high-speed development and intersections with multiple disciplines, and gradually formed frontier branches such as modern cellular immunology and immunogenetics. Meanwhile, immunology is an advanced discipline which is closely related to clinical applications. Therefore, immunology plays a key role in medical science, and thus become an important compulsory course for the students of medicine or biology.

The contents of this textbook covers the knowledge from the basis of immunology to clinical applications, including overview of immunology, the antigens, components in immune system (immune organs, immune cells, immune molecules, etc.) and immune responses. It also involves the applications of immunology (immunological techniques, immunoprophylaxis and immunotherapy, etc.), immune-related diseases and immunity in infectious diseases. This edition of Medical Immunology is intended as a comprehensive, concise and valuable textbook for the foreign medical students studying in China and also suitable for 5-year program Chinese medical students to learn the basic knowledge of immunology and to build up solid foundations for subsequent clinical courses of study and future academic studies.

This textbook was edited and adapted on the basis of *Textbook of Immunology* [Sunil Kumar Mohanty, et al. Jaypee Brothers Medical Publishers (P) Ltd.(2nd edition, 2014)]. Sixteen professors from different universities who have been experienced in teaching immunology for foreign medical students joined the team for the work of this textbook. They also added accurate and up-to-date knowledge into each chapter according to the development of immunology, e.g., Chapter 16 is a completely new part in which the author explained the mechanisms of immunity in viral, bacterial, fungal and parasitic infections, considering the actual health conditions in some countries where the foreign medical students come from. There might be some mistakes or omissions in this textbook since immunology is developing

rapidly, we sincerely hope the readers give valuable opinions and comments through email so that we can make corrections in the next edition.

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January 11, 2017

# Contents

## 目 录

<b>Chapter 1 Introduction</b> .....	1
A BRIEF OVERVIEW OF IMMUNOLOGY .....	1
HISTORY OF IMMUNOLOGY.....	10
STUDY QUESTIONS.....	13
SUGGESTED READINGS .....	13
<b>Chapter 2 Antigen</b> .....	14
DEFINITION .....	14
EPITOPES .....	14
CLASSIFICATION OF ANTIGENS BASED ON	
IMMUNE RESPONSE.....	15
DETERMINANTS OF IMMUNOGENICITY .....	15
ANTIGEN RECEPTORS .....	16
ANTIGENIC SPECIFICITY .....	17
STUDY QUESTIONS .....	18
SUGGESTED READINGS .....	18
<b>Chapter 3 Antigen Recognition Molecules</b> .....	19
ANTIBODIES—IMMUNOGLOBULINS.....	20
MAJOR HISTOCOMPATIBILITY COMPLEX .....	25
STUDY QUESTIONS.....	28
SUGGESTED READINGS .....	28
<b>Chapter 4 The Complement System</b> .....	29
COMPLEMENT ACTIVATION .....	29
REGULATION OF THE COMPLEMENT	
SYSTEM .....	31
BIOLOGICAL CONSEQUENCES OF	
COMPLEMENT ACTIVATION.....	32
DEFECTS IN THE COMPLEMENT SYSTEM.....	34
STUDY QUESTIONS .....	34
SUGGESTED READINGS .....	35
<b>Chapter 5 Organs and Tissues of the Immune System</b> .....	36
LYMPHOID ORGANS.....	36
STUDY QUESTIONS.....	39
SUGGESTED READINGS .....	39
<b>Chapter 6 Immune Cells</b> .....	41
LYMPHOCYTES.....	41
PHAGOCYTIC CELLS.....	47
DENDRITIC CELLS .....	48
STUDY QUESTIONS.....	48
SUGGESTED READINGS .....	48
<b>Chapter 7 Immune Response</b> .....	49
ANTIGEN PROCESSING AND	
PRESENTATION .....	49
ACTIVATION OF HELPER T LYMPHOCYTES .....	51
HUMORAL IMMUNE RESPONSE	
(HUMORAL IMMUNITY).....	55
PRIMARY AND SECONDARY RESPONSE .....	58
FACTORS INFLUENCING ANTIBODY	
PRODUCTION .....	59
CELL-MEDIATED IMMUNE RESPONSE	
(CELL-MEDIATED IMMUNITY).....	60
CYTOKINES.....	64
THEORIES OF IMMUNE RESPONSE.....	71
STUDY QUESTIONS.....	73
SUGGESTED READINGS .....	75
<b>Chapter 8 Immunological Tolerance</b> .....	76
CENTRAL T CELL TOLERANCE TO SELF-	
ANTIGENS.....	76
PERIPHERAL T CELL TOLERANCE TO SELF-	
ANTIGENS.....	77
B CELL TOLERANCE TO SELF-ANTIGENS .....	78
ARTIFICIALLY INDUCED TOLERANCE IN	
VIVO.....	79
STUDY QUESTIONS.....	80
SUGGESTED READINGS .....	80

<b>Chapter 9 Hypersensitivity</b> .....	81	FACTORS FAVORING ALLOGRAFT SURVIVAL.....	140
DEFINITION.....	81	MECHANISM INVOLVED IN GRAFT REJECTION	
GELL AND COOMBS CLASSIFICATION.....	81	.....	142
IMMEDIATE TYPE I HYPERSENSITIVITY.....	81	TEMPO OF REJECTION.....	145
TYPE II HYPERSENSITIVITY REACTION		STUDY QUESTIONS.....	147
(ANTIBODY-DEPENDENT CYTOTOXICITY).....	89	SUGGESTED READINGS .....	147
TYPE III HYPERSENSITIVITY REACTION		<b>Chapter 14 Immunological Techniques</b> .....	149
(IMMUNE COMPLEX-MEDIATED).....	93	STAGES OF ANTIGEN-ANTIBODY	
TYPE IV CELL-MEDIATED (DELAYED)		INTERACTIONS.....	149
HYPERSENSITIVITY .....	96	MEASUREMENT OF ANTIGEN AND ANTIBODY	
STUDY QUESTIONS.....	101	.....	149
SUGGESTED READINGS .....	101	PRECIPITATION REACTIONS.....	149
<b>Chapter 10 Autoimmunity</b> .....	102	AGGLUTINATION REACTION.....	154
PROBABLE MECHANISMS OF		MONOCLONAL ANTIBODIES AND	
AUTOIMMUNITY .....	102	HYBRIDOMA TECHNIQUE .....	167
AUTOIMMUNE DISEASES.....	107	STUDY QUESTIONS.....	170
STUDY QUESTIONS.....	109	SUGGESTED READINGS .....	171
SUGGESTED READINGS .....	110	<b>Chapter 15 Immunoprophylaxis &amp;</b>	
<b>Chapter 11 Immunodeficiency Disorders</b> .....	111	<b>Immunotherapy</b> .....	172
PRIMARY IMMUNODEFICIENCIES.....	111	IMMUNOPROPHYLAXIS.....	172
SECONDARY (ACQUIRED) IMMUNODEFICIENCIES		IMMUNOTHERAPY.....	179
.....	117	STUDY QUESTIONS.....	183
STUDY QUESTIONS.....	125	SUGGESTED READINGS .....	183
SUGGESTED READINGS .....	125	<b>Chapter 16 Immunity in Viral, Bacterial,</b>	
<b>Chapter 12 Tumor Immunology</b> .....	126	<b>Fungal, and Parasitic</b>	
CANCER: ORIGIN .....	126	<b>Infections</b> .....	184
TUMOR ANTIGENS.....	129	IMMUNITY IN VIRAL INFECTIONS .....	184
CANCER IMMUNOTHERAPY.....	134	IMMUNITY IN BACTERIAL INFECTIONS.....	188
STUDY QUESTIONS.....	136	IMMUNITY IN FUNGAL INFECTIONS .....	197
SUGGESTED READINGS .....	137	IMMUNITY IN PARASITIC INFECTIONS .....	198
<b>Chapter 13 Transplantation Immunology</b> .....	138	STUDY QUESTIONS.....	204
GRAFT REJECTION.....	138	SUGGESTED READINGS .....	204

# Chapter 1

one

## Introduction



### A BRIEF OVERVIEW OF IMMUNOLOGY

Pathogenic microorganisms are endowed with special properties that enable them to cause disease, if given the right opportunity. If microorganisms never encounter resistance from the host, we would constantly be ill and would eventually die of various diseases. But in most cases, our body defenses prevent them of occurrence. In some instances, the body does not allow the organisms to enter. In others, even if they enter, they are eliminated by different mechanisms. Even if they remain inside, the defenses combat with them. Our ability to ward off disease in general is called resistance (immunity). Vulnerability or lack of resistance is susceptibility.

The term immunity is derived from the Latin word *immunitas*. Immunity is defined as the resistance exhibited by the host towards injury caused by the microorganisms and their products.

Immunology is the study of the ways in which the body defends itself from infectious agents and other foreign substances. It mainly focuses on tissue structures and physiological functions of the immune system. It reveals response processes and rules of the immune system recognizing and eliminating harmful organisms and their components from different aspects and levels, applies these rules to clarify the mechanism of occurrence and development of diseases, and achieves the purpose of disease prevention. This textbook mainly introduces the immune system including immune organs, immune cells & immune molecules (antibodies, complements, cytokines, adhesion molecules and MHC etc.), immune response, immune diagnosis, immunotherapy, immunoprophylaxis and immunological diseases. All of these parts will be illustrated in detail in the following chapters.

### Composition of Immune System

Immune system consists of a network of cells, molecules, tissues and organs which work together to protect the body (Fig.1.1).

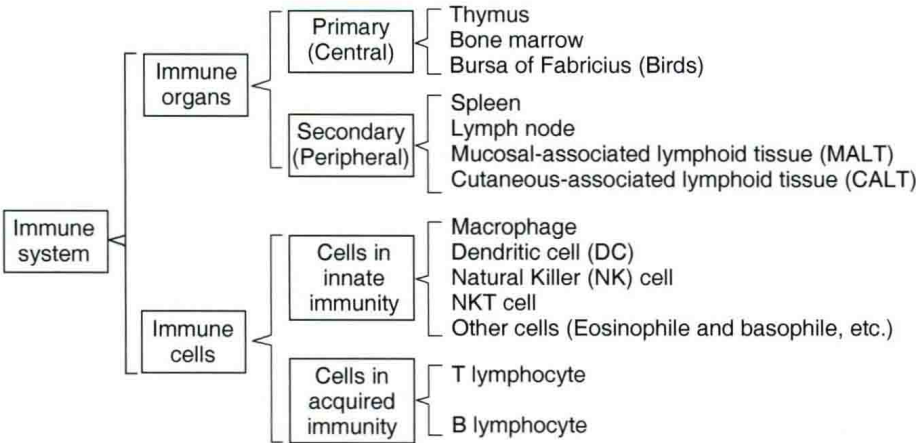


Fig. 1.1 Composition of immune system

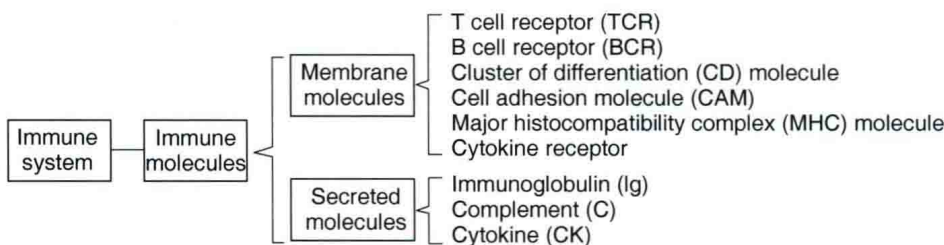


Fig. 1.1 Composition of immune system (continued)

## Functions of Immune System

Protection against the infectious agents is only one of the consequences of the immune response. The immune system of an individual recognizes and eliminates not only the invading microorganisms (bacteria, viruses, fungi, mycoplasma, chlamydia and parasites, etc.), but also the mutant, cancerous, aging or dead cells and other harmful components. The functions of immune system include immune defense, immune homeostasis and immune surveillance

(Table 1.1), which play key roles in different aspects to protect individuals against diseases. Once the immune system function abnormally, pathological consequences may occur and exhibit corresponding diseases. Meanwhile, the immune system does not exist in isolation, it is also regulated by the nervous system and endocrine system. All of these three systems interact with each other and affect each other, therefore, they form a complicated neuroendocrine immune network and maintain the balance of internal environment.

Table 1.1 Functions of immune system

Functions	Physical consequences (beneficial)	Pathological consequences(harmful)
Immune defense	Protect individual from the invasion of pathogenic microorganisms	Hypersensitivity / Immunodeficiency disease
Immune homeostasis	Recognize and eliminate the injured, aging and dead cells	Autoimmune disease
Immune surveillance	Continually recognize and remove "non-self" components such as mutant cells or malignant cells	Cellular canceration; continuous infections

## Types of Immunity

Immunity to infectious agents can result from innate immunity, acquired immunity or both (Fig. 1.2).

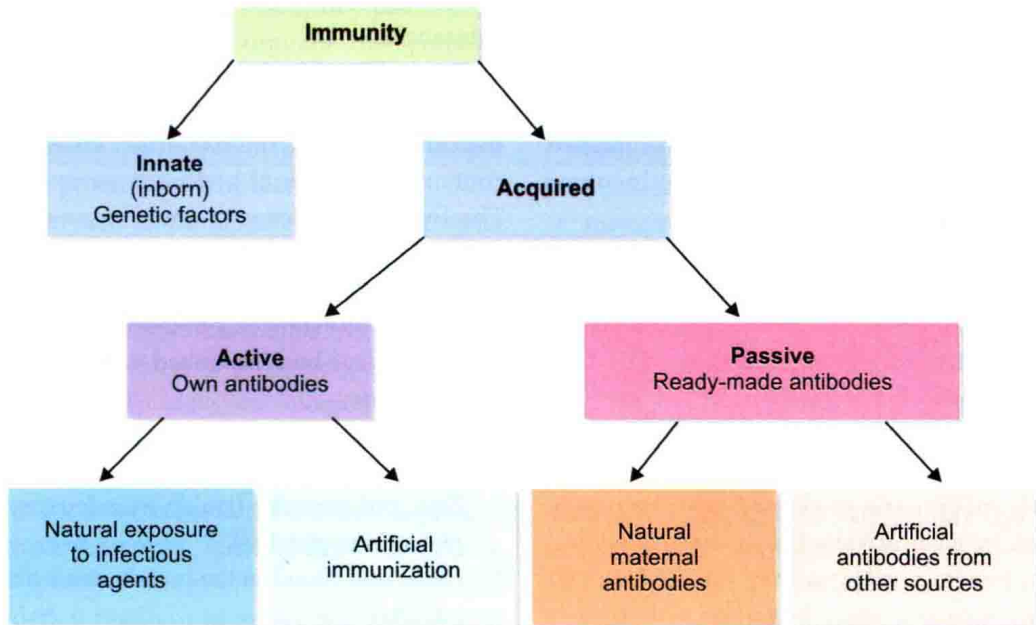
### Innate Immunity

Innate immunity is an invariable, hereditary response—an inborn defense. It is independent of previous exposures to disease causing agents and foreign substances. The innate immunity depends on the non-specific mechanisms, molecular defenses and the activity of the phagocytic cells.

Innate immunity may be considered at the level of species, races and individuals. In species immunity, all individuals of a species are born with resistance to an infectious agent that causes disease in another species. For example, human beings are immune to most infectious agents that causes

disease in pets and other domesticated animals. Human beings are insusceptible to rinderpest or distemper, which the canines suffer. Similarly, the animals show innate immunity to many human pathogens. The mechanisms of species immunity are not clearly understood, but may be due to physiological and biochemical differences between the tissues of the different host species that determine, whether or not a pathogen can multiply in them.

Within a species, different races show difference in susceptibility to infections. This is known as racial immunity. The classical example of racial immunity is the resistance to anthrax by Algerian sheep, whereas sheep in general are susceptible to anthrax. It has been reported that the African Americans in the USA are more susceptible to tuberculosis than the Caucasians.



**Fig. 1.2** Various types of immunity. Non-specific immunity is largely innate or inborn, whereas specific immunity is acquired.

An interesting instance of genetic resistance to *Plasmodium falciparum* malaria is seen in some parts of Africa, where sickle cell anemia is prevalent. The hereditary abnormality of the red cells confers immunity to infection by malaria parasite. Even resistance to human diseases, such as measles, can vary from person to person. For example, although the effect of measles is usually relatively mild in European ancestry, the disease devastated the population of Pacific Islanders, when they were first exposed to measles by European explorers. Natural selection resulting from the exposure of many generations to the measles virus, presumably led to the more frequent inheritance of genes that conferred some resistance to the virus.

Individuals in a race exhibit difference in innate immunity. The genetic basis of individual immunity is evident from studies on the incidence of infectious diseases in twins. Homozygous twins exhibit similar degree of resistance or susceptibility to lepromatous leprosy and tuberculosis. An individual's resistance to disease also depends on age, nutritional status, stress, hormone influence and general health in addition to genetic factors.

**Age:** People at both young and old age carry higher susceptibility to infections in comparison

to adults. The heightened susceptibility of the fetus to infection is related to the immaturity of the immune system. In neonates, the antibodies, immune competent cells and also the complement level remain suboptimal. The fetus in uterus is normally protected by the maternal antibodies, but some organisms (*Toxoplasma gondii*, rubella virus, cytomegalovirus, herpesviruses, *Treponema pallidum*, *Borrelia burgdorferi*, hepatitis B virus, human immunodeficiency virus, etc.) cross the placental barrier and cause respective diseases. Newborn animals (suckling mice) are more susceptible to coxsackievirus.

Tinea capitis caused by *Microsporum audouinii* is very common in young people, which disappear after reaching puberty. The vaginal epithelium of prepubertal girl is more susceptible to gonococcal infections.

Some infections like poliomyelitis and chickenpox, tend to be more severe in adults than in young children due to hypersensitivity that causes more tissue damage. The old people are prone to infections due to waning of the immune system. The immune system shows the senescence seen in other organs. Cellular immunity is mostly affected.

**Hormonal influence:** Diabetes, hypothyroidism and adrenal dysfunctions are associated with