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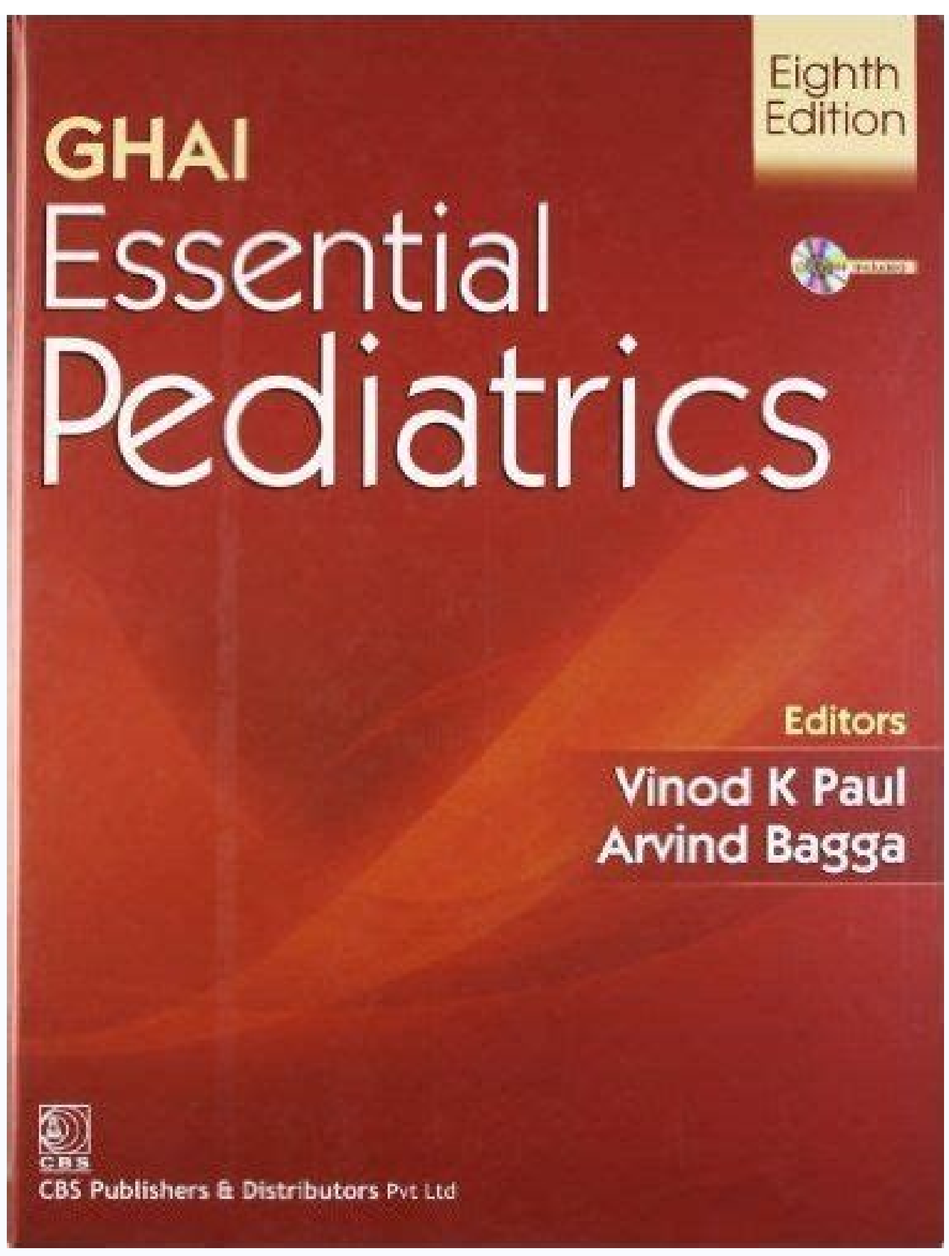

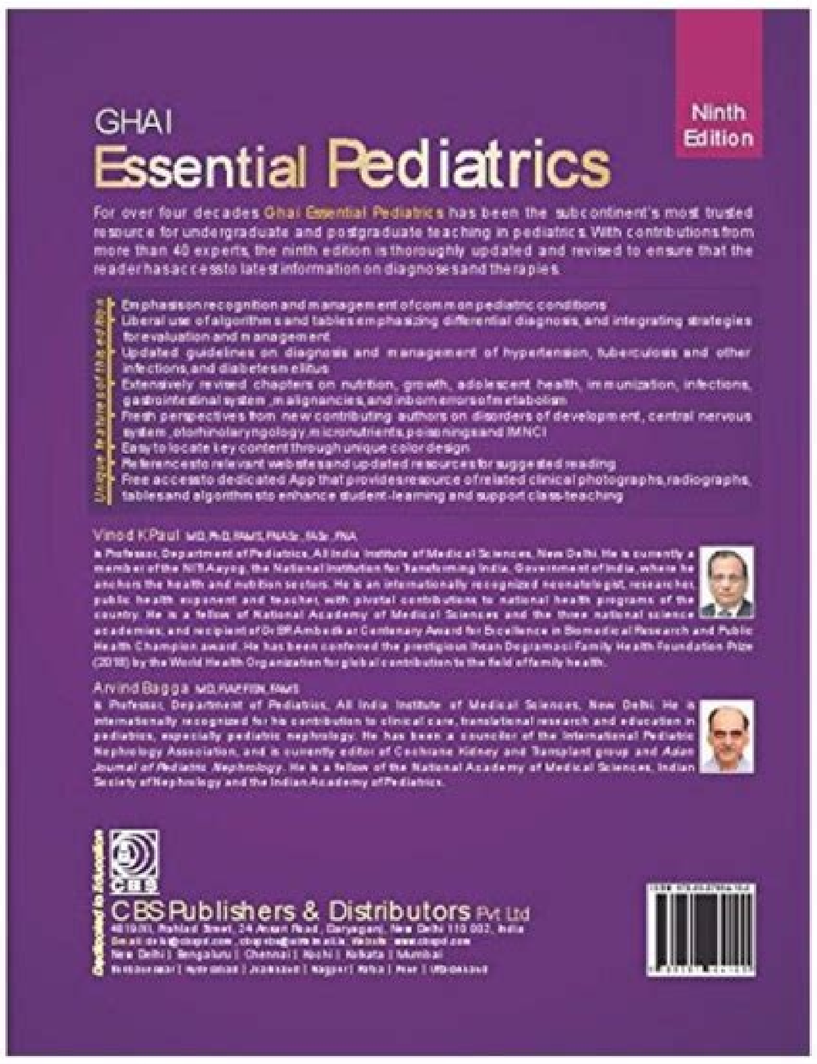

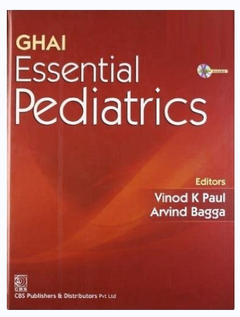

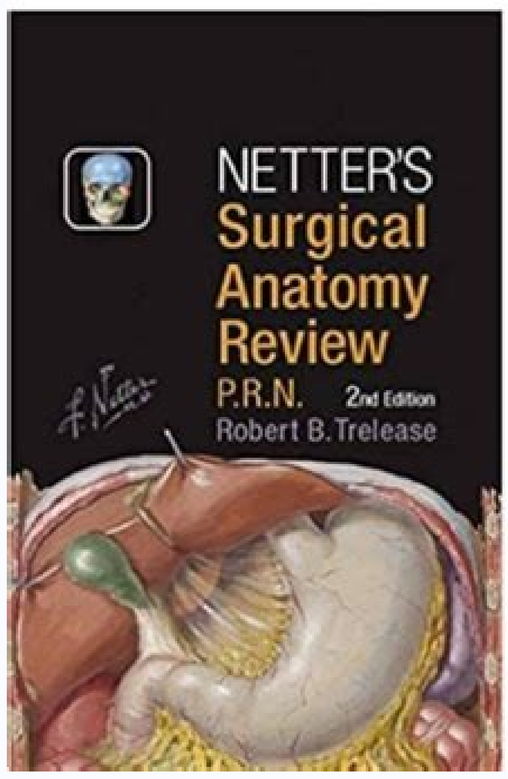

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Some of the chapters in book are as follows: Introduction to PediatricsNormal Growth and its DisordersDevelopmentAdolescent Health and DevelopmentFluid and Electrolyte DisturbancesNutritionMicro-nutrients in Health and DiseaseNewborn InfantsImmunization and ImmunodeficiencyInfections and InfestationsDiseases of Gastrointestinal System and LiverHematological DisordersOtolaryngologyDisorders of Respiratory SystemDisorders of Cardiovascular SystemDisorders of Kidney and Urinary TractEndocrine and Metabolic DisordersCentral Nervous SystemNeuromuscular DisordersChildhood MalignanciesRheumatological DisordersGenetic DisordersInborn Errors of MetabolismEye DisordersSkin DisordersPoisonings, Injuries and AccidentsPediatric Critical CareCommon Medical ProceduresRational Drug TherapyIntegrated Management of Neonatal and Childhood IllnessRights of Children Authors: Contributors: Overview OP Ghai Pediatrics is the Golden book for pediatrics subject in fourth year. No doubt why it is the course textbook and is recommended by every doctor and student doing MBBS. The book has superb illustrated tables, diagrams and flowcharts. Explanations are easy to understand and there is no error spotted yet. In the end of every chapter, they usually have “Suggested reading” in case a student wants to jump in deep to the topic. The images used are clear-cut, and the standard set by Ghai Pediatrics is worth noting. It is definitely the recommended book if you are or will be preparing for NEET PG exam after MBBS. You May Also Need Dhingra ENT PDF Book Free Download [Direct Link] Suggestions to those studying Pediatrics in Fourth Year MBBS are as follows: You cannot simply mug up and pass. This subject will be valuable to you for rest of your medical career. Try diving in deep and learning every bit of it. The text isn’t really vast.Like said, you just don’t need to pass, you need to learn it by heart. Apart from that, 5-year question papers for your university are enough, you can try to do 10 years if you want.Stick to OP Ghai Pediatrics, it will sail your boat smoothly.To set up the base, you will need to regularly attend the clinical wards and see patients. It is suggested strictly to carry the book and make notes of a case before seeing it. Like if you wish to see a patient with Cerebral palsy, you can read the notes, and then make key-points of what you are going to question the patient and spot the clinical features. However, do not go direct diagnosis with “I know this is CP” in mind.This site will provide you a key look at how you should approach the patients in wards and set up your base. There are some clinical questions-to-ask from the patients, signs to note and some texts you should know, all in one article. Just check out some given below: OP Ghai Pediatrics Textbook 9th Edition PDF Book Download You can download the OP Ghai Pediatrics textbook by Google drive links given below. If the link is not working, do let us know using the comments section, we will readily update it. If you are unable to locate the links, please refresh the page. Bank Offer (7): Flat INR 300 Instant Discount on SBI Debit Card Trxn. Min purchase value INR 5000 See All No Cost EMI: Avail No Cost EMI on select cards for orders above ₹3000 Details Something went wrong. Wait a moment and try again. Bank Offer (7): Flat INR 300 Instant Discount on SBI Debit Card Trxn. Min purchase value INR 5000 See All No Cost EMI: Avail No Cost EMI on select cards for orders above ₹3000 Details Cashback: Super Offer: Claim your offer on any product of your choice and save - Click here to claim. Details Academia.edu uses cookies to personalize content, tailor ads and improve the user experience. 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PhD. FAMs. FNAsc. FAsc. FNA Professor. Department of Pediatrics All India Institute of Medical Sciences, New Delhi Member. NITI Aayog National Institution for Transforming India Government of India. New Deihl Arvind Bagga MD. FIAP, F1sN. FAMs Professor, Department of Pediatrics All India Institute of Medical Sciences, New Deihl ~ CBS CBS Publishers & Distributors Pvt Ltd New Delhi • Bengaluru • Chennai • Kochi • Kolkata • Mumbai Bhuboneswar • Hyderabad • Jharkhand • Nagpur • Patna • Pune • Uttarakhand Disclaimer Medical knowledge Is constantly changing. As new Information becomes available. changes In treatment. procedures, equipment and the use of drugs become necessary. The contributors, editors and the publishers. as far as possible, have taken care to ensure that the Information given In this text Is accurate and up-to-date. However, the readers are strongly advised to confirm that the Information. especlally with regard to drug usage, complies with the latest leglslatlon and standards of practice. Notice Research In treatment and drug therapy is continually In progress throughout the world. Recommendations and contraindications In dosage schedules require constant updating and change, both from year-to-year and country-to-country. Different drugs may have a similar name in other countries or the same drugs may be packed In different strengths. It is, therefore. advisable to consult the product Information sheet provided with each drug. particularly In the case of new, foreign or rarely used drugs, to ensure that changes have not been made In the recommended dosages. 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Ground Floor, Rameswar Shaw Road, Kolkata-700014 (West Bengal), India • -moR: kolkotalllcbspd.com Ph: +91 -33-2289-1126, 2289·1127, 2289-1128 • Mumbai: 83-C, Dr E Moses Road, Worll, Mumbal-400018, Maharashtra Ph: +91-22-24902340/~1 Fax: +91 ·22·24902342 a-moll: mumbolOcbspd.com Representatives • Bhubaneswar • Patna 0-9911037372 0-9334159340 •Hyderabad 0-9885175004 • Pune 0-9623451994 • Jharkhand 0-9811541605 . • Nagpur 0-9021734563 • Uttarakhand 0-9716462459 .- Printed at Thomson Press (India) Ltd. ., - to Ouryarents for yrovidina us the oyyortunity to Cearn and serve Our teachers and mentors for in~artin8 knowfe'ae and incu(catina va(ues Our co(feaaues for their affection and inpiration Our families for their yatience and unstinted suyyort -~ditors -. ~- --- Prof. Om Prakash Ghai P rof. Om Prakash Ghai had a distinguished academic tenure at the All India Institute of Medical Sciences, New Delhi. He started the Department of Pediatrics in 1959 with six beds for children. Under his leadership, the department evolved into a multispecialty centre of international repute. After his retirement as Dean of the Institute and Professor and Head of the Department of Pediatrics, he chaired the Department of Pediatrics at the University College of Medical Sciences, Delhi, where he served until 1991. Prof. Ghai was President of the Indian Academy of Pediatrics in 1978 and President of the International College of Pediatrics from 1987to1990. The International Pediatric Association presented him the prestigious 'Insignia of Merit Medallion' (1977) for his outstanding contributions to child welfare. The Indian Council of Medical Research awarded him the Dr Kamla Menon Prize (1983) and Amrut Mody Prize (1985). The Medical Council of India bestowed on him the Dr BC Roy Memorial Award for 'Eminent Medical Teacher' (1987). He was awarded honorary fellowships of the American Academy of Pediatrics, the National Academy of Medical Sciences and the Indian Academy of Pediatrics. Prof. Ghai served as a short-term consultant to the World Health Organization and Asian Development Bank. He was a member of the Technical Advisory Group of the Control of Diarrheal Diseases Program of the World Health Organization (1987-89). He was member of the National Children's Board and several expert groups of the Government of India, UNICEF and Indian Council of Child Welfare. He was the editor of Indian Pediatrics and member of the editorial advisory boards of multiple journals. Prof. Ghai was a teacher par excellence, an inspiring leader and a true visionary. His name shall always remain etched in the annals of pediatrics of our country. ··~ "J ' Preface to the Ninth Edition As we present the ninth edition of Essential Pediatrics, we are humbled by the role this textbook has played .t"\.. in imparting knowledge in child health to generations of doctors. Four decades ago, late Prof. OP Ghai foresaw the need for a textbook of pediatrics for medical students of the country and South Asia. Thereafter,. each new edition has attempted to present updated knowledge to an expanding group of undergraduate and postgraduate students. For India, the next three decades offer a never-before window of opportunity to accelerate its economic growth and emerge as a nation that would banish poverty forever, and attain heights of prosperity and well-beil\.s:. We are transitioning through a demographic phase characterized by an exceptionally high young population constituting a workforce that is available for economic activity and nation-building. This demographic dividend can be realized only if children and adolescents are healthy, strong and intelligent. Pediatrics, the science and art of child healthcare, has thus acquired a new meaning and relevance in the context of new India. With Ayushman Bharat, the nation has committed itself to a comprehensive primary health S)"'$tem and to ensure financial protection for the vulnerable families in accessing care for children and adults alike. Preventin~ and promotive health and nutrition will gain further ground, and the agenda of health loss due to pneumonia.. diarrhea, other infections, complications of preterm birth and vaccine preYentable diseases would receive even more attention. Adolescent health and development will be increasingly important in the coming yea~. We are already witnessing an upsurge in demand for healthcare for chronic systemic diseases, developmental d.iso.nie~.. disabilities and childhood origins of adult diseases. The realization that children have the right to secondary and tertiary health care has stimulated the development of pediatric superspecialty programs. The present edition of Essential Pediatrics continues to respond to these developments. The book maintains its focus on undergraduate medical students. While we ensure that the 'must know' contents are thoroughly covered.. we provide a glimpse of the 'should know' curriculum. We have ensured that the size of the book enables it to be readable and handy enough for the classroom and the bedside-as Prof. Ghai always reminded u~ Gh'en the emphasis on updated management of common childhood illnesses, primary care physicians and pediatricians would find the book useful. As before, there are strong sections on core areas that continue to serve the nt'('\.is o.f postgraduate students. A number of changes have been incorporated in this edition. We welcome new authors for chapters on disorders of development, central nervous system, micronutrients, otorhinolaryngology, poisoning and accidents, and integrated management of childhood illnesses. Most other chapters, especially on growth, nutritiOJ\, immnmizatiOl\. malignancies, genetics, inborn errors of metabolism and infections, have been revised. The CBSiCentrnl App featuring illustrations, clinical photographs, tables and algorithms shall serve as a useful educ,1tional resource. The editors are grateful to all the contributing authors for their scholarly inputs and ensuring that the chapters continue to provide succinct and updated information, meeting the learning needs of students. We thank our undergraduate and postgraduate students for their suggestions on content. Dr Priyanka Khandelwal has helped during multiple stages of preparation, ensuring consistent style across chapte~. Dr Aditl Sinha, Dr Biswaroop Chakrabarty and Dr Jitendra Meena read through several sections and made useful suggestions. We thank our colleagues at CBSP&D, Mr YN Arjuna and Ms Ritu Chawla, for ensuring the quality of pul"'llication of previous and the present editions. We gratefully acknowledge our colleagues at the AIIMS and other centers for contributing illustrations and the support of our secretaries, Mr Anil Bhutani and Mr Akhilesh Sharma. We whole-heartedly thank our readers for the trust, support and suggestions. Vlnod K Paul ANlndBagga ......~~--~~~~~~~~~--~~~~~--.- ~·~ · ~-----.~~~..·~·.....,....,,_......~~~--_,,.~--~.~_,...._...~~~~~~ List of Contributors Komron Afzal Professor Department of Pediatrics Jawaharlal Nehru Medical College Allgarh Muslim University Allgarh AnuJa Agarwata Dietitian Department of Pediatrics All India Institute of Medical Sciences New Delhi Ramesh Agarwal Professor Department of Pediatrics Division of Neonotology All India Institute of Medical Sciences New Deihl ' Ashok K Deorarl Professor and Head Department of Pediatrics All India Institute of Medical Sciences New Deihl lusher R Godbole Consultant Pediatric Endocrinologist Assistant Professor, Dr Vasant Power Medical College, Nashlk Director. Harmony Health Hub, Nashlk Sheftall Gulati Professor Deportment of Pediatrics Division of Neurology All Indio Institute of Medical Sciences New Deihl Modhullka Kabra Professor Department of Pediatrics Genetics Unit All India Institute of Medical Sciences New Deihl Sushll K Kabra Professor Department of Pediatrics Division of Pulmonology and Intensive Care All India Institute of Medical Sciences New Deihl Neena Khanna Professor Department of Dermatology All India Institute of Medical Sciences New Deihl Varun Alwodhl Senior Resident Kolawatl Soran Children's Hospital Lady Hordlnge Medical College New Delhi NeerJo Gupta Assistant Professor Deportment of Pediatrics Genetics Unit All India Institute of Medical Sciences New Deihl Ajay Khero Public Health Specialist and Deputy Commissioner Ministry of Health and Family Welfare Government of India. New Delhi Arvlnd Bagga Professor Deportment of Pediatrics Division of Nephrology All lndlo Institute of Medical Sciences New Deihl Borath Jagadlsan Additional Professor Department of Pediatrics Jawaharlal Institute of Postgraduate Medical Education and Research Puducherry Rakesh Lodho Professor Department of Pediatrics Division of Pulmonology and Intensive Care All India Institute of Medical Sciences New Delhi Anurag BaJpal Pediatric and Adolescent Endocrinologist Regency Center for Diabetes Endocrinology and Research. Kanpur Fortis Memorial Research Institute Gurugram Vondono Join Professor Department of Pediatrics Division of Endocrinology All India Institute of Medical Sciences New Delhi PSN Menon Consultant and Head Department of Pediatrics Jaber Al-Ahmed Armed Forces Hospital Kuwait Formerly Professor, Department of Pediatrics All India Institute of Medical Sciences New Deihl Neetu Sharl Assistant Professor Department of Dermatology All Indio Institute of Medical Sciences New Deihl VIJoyolokshml Bhatia Professor Deportment of Endocrinology Sanjoy Gandhi Postgraduate Institute of Medical Sciences Lucknow Blswaroop Chakrabarty Assistant Professor Department of Pediatrics Division of Neurology All Indio Institute of Medical Sciences New Deihl Kana Ram Jot Assistant Professor Department of Pediatrics Division of Pulmonology and Intensive Care All India Institute of Medical Sciences New Deihl R Krishna Kumar Cllnlcal Professor and Head Pediatric Cardiology Amrlta Institute of Medical Sciences and Research Centre Koehl Rashml Kumar Professor Department of Pediatrics King George's Medical University Lucknow Praveen Narsarla Consultant Pediatric Intensive Care Unit Nogarmol Modi Sevo Sadan, Ranchi Vlnod K Poul Member. NITI Aayog National Institution for Transforming India Government of India. New Delhi Professor of Pediatrics All India Institute of Medical Sciences New Deihl Menu RaJ Professor and Senior Consultant Divisions of Pediatric Cardiology and Public Health Research Amrlta Institute of Medical Sciences and Research Center • Koehl - xii Prem Sagar Assistant Professor Deportment of Otorhinolaryngology and Head-Neck Surgery Ail India Institute of Medical Sciences New Deihl Sandeep Samant Professor Deportment of Otolaryngology and Head-Neck Surgery Feinberg School of Medicine Northwestern Memorial Hospital Greater Chicago. IL Jhuma Sankar Assistant Professor Deportment of Pediatrics Division of Pulmonology and Intensive Core All India Institute of Medical Sciences New Deihl Naveen Sankhyan Associate Professor Deportment of Pediatrics Advanced Pediatric Center Postgraduate institute of Medical Education and Research Chandigarh Rachna Seth Professor Department of Pediatrics Division of Oncology All Indio Institute of Medical Sciences New Delhi Essentlel Pediatrics RaJeev Seth Senior Consultant Pediatrician Max Smart Super-Specialty Hospital and Rainbow Children's Hospital New Delhi 1\Jllka Seth Professor Deportment of Hematology All India Institute of Medical Sciences New Deihl RaJnl Sharma Assistant Professor Department of Pediatrics Division of Endocrinology All Indio Institute of Medical Sciences New Deihl Anahu Srivastava Professor Department of Pediatric Gastroenterology sanjay Gandhi Postgraduate Institute of Medical Sciences Lucknow RN Srivastava Senior Consultant Pediatric Nephrology lndroprastha Apollo Hospitals New Delhi Radhlka Tandon Professor of Ophthalmology Dr Rojendra Prasad Centre for Ophthalmic Sciences All India Institute of Medical Sciences New Delhi Surjlt Singh Professor and Head Deportment of Pediatrics Chief, Allergy Immunology Unit Advanced Pediatrics Centre Post Graduate Institute of Medical Education and Research Chandigarh Alok Thakar Professor Department of Otorhlnolaryngology and Head-Ne ck Surgery All India Institute of Medical Sciences New Deihl Tanu Slnghal Consultant Pediatrics and Infectious Disease Koklloben Dhirubhai Ambanl Hospital and Medical Research Institute Mumbai Anu Thukral Assistant Professor Deportment of Pediatrics Division of Neonatology All India Institute of Medical Sciences New Deihl Aditl Sinha Assistant Professor Department of Pediatrics Division of Nephrology All India Institute of Medical Sciences New Deihl Surender K Yachha Professor Deportment of Pediatric Gostroenterology Sanjoy Gandhi Postgraduate Institute of Medical Sciences. Lucknow Contents Preface to the Ninth Edition Preface to the First Edition Ust of Contributors vii Ix xi 1. Introduction to Pediatrics Vlnod K Paul Pediatrics as a specialty l Historical perspective l Challenge of high child mortality 2 National programs on child health 3 Future of child health 6 7. Nutrition Food 86 Dietary standards 88 Balanc ed diet 90 Normal balanced diet for various age groups 91 Undernutrltlon 93 Management of malnutrition 97 8. Micronutrients in Health and Disease 2. Growth 7 Ramesh Agarwal, Naveen Sankhyan, Vandana Jain 86 Vlnod K Paul, Anu}a Agarwa/a, Rakesh Lodha 109 Rajn/ Sharma. Arvind Bagga Fat-soluble vitamins 109 Water-soluble vitamins 117 Minerals 121 Trace elements 122 Factors affecting growth 7 Somatic growth 11 Assessment of physical growth 11 Disorders of growth 31 Abnormalities of head size and shape 35 9. Newborn Infants 125 Ramesh Agarwal. Vlnod K Paul, Ashok K Deorarl 3. Development 38 Ramesh Agarwal, Naveen Sankhyan Normal development 38 4. Developmental and Behavioral Disorders 54 Blswaroop Chakrabarty, Sheftall Gulati Global developmental delay, Intellectual disability 54 5. Adolescent Health and Development 60 Tushar R Godbole. Vijayalakshml Bhatia Physical aspects 60 Problems faced by adolescents 62 Government Interventions In adolescent healthcare 67 6. Fluid and Electrolyte Disturbances Kamran Afzal Composition of body fluids 68 Deficit therapy 71 Sodium 71 Potassium 74 Calcium 76 Magnesium 80 Acid-base disorders 80 Resuscitation of a newborn 126 Level of newborn care 133 Core of normal newborn babies 133 Evaluation of newborn 136 Thermal protection 142 Breastfeeding 145 Core of low birth weight babies 149 Kangaroo mother care 151 Fluid and electrolyte management 154 Infections In the neonates 159 Perinatal asphyxia 162 Respiratory distress 164 Jaundice 168 Congenital malformations 172 Transport of neonates 174 Follow-up of high-risk neonates 175 Metabolic disorders 175 Effect of maternal conditions on fetus and neonates 176 68 10. Immunization and Immunodeficiency Adltl Sinha. Surj/t Singh Immunity 178 Primary Immunodeficiency disorders 178 Immunization 182 Commonly used vaccines 185 178 Essential Pediatrics . . xiv 11. Infections and Infestations 205 371 Sushi/ K Kabra ronu Singhal. Rakesh Lodha, Sushi/ K Kabra Fever 205 Common viral Infections 209 HIV lntoc llon, acquired lmmunodeflclency syndrome 224 Common bacterial Infections 234 Tuberculosis 243 Rlckettslol and mycoplasmo Infections 251 Fungal Infections 253 Protozoa! Infections 254 Congenital and perinatal Infections 264 Helmlnthlc Infestations 265 Rational antimicrobial therapy and ontlmlcroblol resistance 271 Health core associated Infections and Infection control 271 12. Diseases of Gastrointestinal System and Liver 273 Anshu Srivastava, Barath Jagadisan, Surender K Yachha Developmental physiology 371 Common respiratory symptoms 372 Investigations for respiratory Illnesses 374 Upper respiratory tract Infections 375 Lower respiratory tract Infections 376 Pneumonia 377 Acute respiratory tract Infection control program 380 Bronchlollls 380 Bronchial asthma 382 Foreign body aspiration 390 Approach to chronic cough 390 Suppurotlve lung disease 391 Empyemo thoracls 391 Cystic fibrosis 392 Acute respiratory distress syndrome 393 16. Disorders of Cardiovascular System 394 R Krishna Kumar, Manu Raj Gastrointestinal system 27 3 Acute diarrhea 287 Persistent diarrhea 293 Chronic diarrhea 295 Gastrointestinal bleeding 303 Disorders of the hepatoblllary system 306 Acute viral hepatitis 31 O Liver failure 31 l Chronic !Iver disease 313 Ascltes 315 Portal hypertension 316 Autoimmune llver disease 319 Chronic hepatitis B Infection 319 Hepatitis C Infection 320 Metobollc llver disease 321 Neonatal cholestasls 325 13. Hematological Disorders 15. Disorders of Respiratory System Congestive cardiac failure 394 Congenital heart disease 398 Acyanotlc congenital heart defects 409 Cyonotlc heart disease 417 Obstructive lesions 425 Rheumatic fever 430 Rheumatic heart disease 434 Infective endocardltls 439 Myocardial diseases 442 Pericardia! d iseases 445 Systemic hypertension 446 Pulmonary arterial hypertension 450 Rhythm disorders 452 Preventing adult cardiovascular disease 458 329 17. Disorders of Kidney and Urinary Tract 460 Tullka Seth Arvlnd Bagga, Ad/ti Sinha, RN Srivastava Anemia 329 Iron deficiency anemia 333 Megoloblastlc anemia 334 Hemolytic anemias 336 Thalossemlas 339 Sickle cell anemia 342 Aplastlc anemia 343 Hematopoletlc stem cell transplantatlon 345 Disorders of hemostasls and thrombosis 347 Thrombotic disorders 354 Disorders of white blood cells 355 Renal anatomy and physiology 460 Diagnostic evaluation 463 Hematurla 466 Protelnurlo 468 Acute glomerulonephrltls 469 Nephrotlc syndrome 472 Chronic glomerulonephrltls 478 Interstitial nephritis 478 Urinary tract Infections 478 Veslcoureterlc renux 480 Acute kidney Injury 482 Hemolytic uremic syndrome 4Bl Chronic kidney disease 488 Renal replacement therapy 492 Disorders of renal tubular transport 492 Nephrollthlosls and nephrocalclnosls 497 Enuresis 499 . Congenital abnormalltles of kidney and 1 Antenatal hydronephrosls 50l ur nary tract 500 14. Otorhinolaryngology Prem Sagar. Alok Thakar, Sandeep Samant Diseases of the ear 357 Diseases of the nose and sinuses 363 Diseases of the oral cavity and pharynx 366 Diseases of the larynx and trachea 368 Diseases of the salivary glands 370 357 Cystic kidney diseases 502 Content• 18. Endocrine and Metabollc Disorders 504 PSN Monon. lwaa Oa)pcil Gonorol prlnclplos 504 Dlsordors or pituitary gland 505 Dlsordors or thyroid Oland 510 Dlsordors or calcium motabollem 616 Dlsordors of adronal glands 518 Oboslly 524 Disorders or the gonadal hormones 529 Disorders of sex devotopmont 536 Diabetes mellltus 540 19. Diseases of Central Nervous System 552 581 Sheftall Gulati Leukemias 593 Chronic myelold leukemia 600 Lymphoma 602 Hodgkin lymphoma 602 Non-Hodgkin lymphoma 604 Retlnoblastomo 607 Wllms tumor 609 Neuroblastoma 610 Malignant tumors of the liver 612 Soft tissue sarcoma 612 Bone tumors 613 Brain tumors 614 Hlstlocytoses 615 Hemophogocytlc lymphohlstlocytoses 617 Oncologlc emergencies 617 Late effects and survivorship 618 Bone marrow transplantation 619 631 Neerja Gupta, Madhul/ka Kabra Chromosomes and genes 631 Chromosomal disorders 632 Down syndrome 635 Turner syndrome 637 Single gene disorders 639 Polygenlc Inheritance 641 Therapy for genetic disorders 641 Prevention of genetic disorders 642 24. Inborn Errors of Metabolism 644 Neerja Gupta, Madhullka Kabra Acute presentation 645 Chronic and progressive presentation 647 25. Ophthalmic Disorders 660 Radhlka Tandon Pediatric eye screening 6tlJ Congenital and developmental abnormalities 661 Acquired eye diseases 662 26. Skin Disorders Approach to evaluation 581 Disorders affecting anterior horn cells 582 Peripheral neuropathles 583 Acute flaccid paralysis 586 Neuromuscular)unction disorders 587 Muscle disorders 589 Rachna Seth 620 Sur/If Singh 23. Genetic Disorders Rashml Kumar 21. Childhood Malignancies 22. Rheumatologlcal Disorders Arlhrl!IB 620 Syotomlc lupus erythematosus 62A Juvenile rJermatomyostlls 625 Scleroderma 626 Mixed connective tissue disease 626 Vascullldes 627 Neurological diagnosis 552 Seizures and epilepsy 553 Congenital matrormallons 557 Neurocutaneous syndromes 558 Infections and acute encephallls syndrome 559 Cerebral palsy 564 Neurological regression 565 Ataxia 567 Movement d isorders 568 Stroke 570 Paraplegia and quadriplegia 573 Headache 574 Raised lntrocronlal pressure, space occupying lesions and hydrocephalus 575 Coma 578 20. Neuromuscular Disorders xv - 669 Neena Khanna, Neetu Bhar/ 593 Basic principles 669 Genodermatoses 672 Nevi 678 Disorders of skin appendages 683 Dermatitis 681 Bullous disorders 688 Disorders of pigmentation 689 Abnormal vascular responses 690 Infections 692 Diseases caused by arthropods 699 Miscellaneous dermatoses 701 27. Poisonings, Injuries and Accidents Jhuma Sankar Injuries and poisoning 704 Rood traffic accidents and falls 704 Burns, electrical and lnhalatlonal Injuries 705 Drowning and near drowning 707 Choking and suffocation 707 Poisoning 707 Common poisonings 712 Envenomatlons 716 Injury control 719 704 - xvi ~~~~~~~~~~--~-~=E=ss=e~n=tl=a~l~P~ed~l~at~r~lc~s~----~----------------~--~-- l 28. Pediatric Critical Care 721 Praveen Narsar/a, Rakesh Lodha J Bone marrow aspiration and biopsy 743 Liver biopsy 744 Assessment of a seriously Ill child 721 Pediatric basic and advanced life support 722 Shock 727 Nutrition In the critically Ill 731 Sedation, analgesia and paralysis 731 Health care associated Infections 732 Blood transfusions 733 30. Rational Drug Therapy 746 Anu Thukral, Kana Ram Jot 31. Integrated Management of Neonatal and Childhood Illness 766 Ajay Khera, Varun Alwadhl 29. Important Medical Procedures ANind Bagga Removal of an aspirated foreign body 736 Nasogastrlc tube Insertion 737 Central venous cannulatlon 737 Capillary blood (heel prick) 738 Umbilical vessel catheterlzatlon 738 Arterial catheterlzation 739 lntraosseous Infusion 739 Lumbar puncture 740 Thoracocentesls or pleural tap 741 Abdominal paracentesls or ascltlc tap 741 Catheterlzatlon of bladder 742 Peritoneal dialysis 742 736 !Integrated management of neonatal and childhood Illness strategy 766 Outpatient management of young Infants age up to 2 months 768 Outpatient management of sick child age 2 months up to 5 years 770 Assess and classify the sick young Infants 775 32. Rights of Children 786 Rajeev Seth Child abuse and neglect 788 Adoption 789 Index 791 Chapter 1 _. ·-- ··-- .... ,..... .... ~ -· Introduction to Pediatrics Vinod K Paul u~·t="fX~ nephrology, pulmonology, infectious disease, critical care, neurology, hemato-oncology, endocrinology, and cardiology). Pediatrics encompasses intensive care of neonates and children using the most sophisticated technology, on the one hand, and, providing home care to newborns and children, on the other. Child health is thus a state-of-the-art clinical science as well as a rich public health discipline. Medical students should possess competencies for the care of healthy and sick children. The agenda of high child mortality due to pneumonia, neonatal infections, preterm birth complications, diarrhea, birth asphyxia and vaccine preventable diseases is still unfinished. The benefits of advancing pediatric speciality care must reach all children. Besides, an increasing body of knowledge on pediatric origins of non-communicable diseases of the adult is set to change the paradigm of child hea lth . Primary prevention and early detection of adult disorders is an important goal of pediatrics. Adolescence offers second chance in life to shape good lifestyles and prepare for adulthood. The branch of medicine that deals with the care of children and adolescents is pediatrics. This term has roots in the Greek word pedo pais (a child) and iatros (healer). Pediatrics covers the age group less than 18 years of age. The goal of the specialty is to enable a child to survive, remain healthy, and attain the highest possible potential of growth, development and intellectual achievement. Child health encompasses approaches, interventions and strategies that preserve, protect, promote and restore health of children at individual and population level. A physician who specializes in the healthcare of children and adolescents is a pediatrician. Children under 15 years of age comprise about 30% of India's population. Childhood is the state when the human being is growing and developing. It is the age to acquire good habits, values and lifestyles that would make children fit, responsible and productive adults and citizens. The family, society and nation are duty-bound to make children feel secure, cared for, and protected from exploitation, violence and societal ills. Female chil~r~n face gender bias in access to healthc~re and .n utnt10n. A civilized society nurtures all its children, girls and boys alike, with love, generosity and benevolence. Child is not a miniature adult. The principles of adult medicine cannot be directly adapted to children. Pediatric biology is unique and risk factors of dise~se are distinct. Clinical manifestations of childhood diseases ma~ be different from adults. Indeed, many disorders are unique to children-these do not occur in adults ..Drug ~osa?es . children are spec ifi'c and not a mathematical m . . derivation of adult dosages. Wholesome nutrih?n ~s even more important for children not only to sustam hfe, but also to ensure their growth and development. HISTORICAL PERSPECTIVE Medical care of children finds place in the ancient Indian, Greek and Chinese systems of health. But as a formal discipline, pediatrics took root in Europe and the US in the 19th century when some of the famous children hospitals were established. BJ Hospital for Children, Mumbai was the first child hospital to be established in India in 1928. Postgraduate diploma in pediatrics was started there in 1944; postgraduate degree programs began in the fifties. Pediatrics became an independent subject in MBBS course in mid-nineties. The first DM program in neonatology started in 1989 at PGIMER, Chandigarh, followed by one in pediatric neurology at AIIMS in 2004. Half a dozen institutions in the country now run DM programs in various pediatric specialities that include nephrology, pulmonology, critical care, hematologyoncology, oncology, cardiology and endocrinology. PEDIATRICS AS A SPECIALITY p d. . . f . ting speciality. It encompasses care h d and adolescents e iatr1cs is a ascma of premature neonates on the one ~ '. h b ch on the other. The discipline of pediatrics as rant e . "alities (such as neona o1ogy mto well-developed superspec1 ' d ... ·~ ; i t 1 2 ~~~~~~~~~~~~E~s~s~e~n~tl~a~l~Pe~d~i~at~rl~c!s CHALLENGE OF HIGH CHILD MORTALITY India has the highest number of child births as well as child deaths for any single nation in the world. Each year, as many as 26 million babies are born in India. This comprises 18% of the global birth cohort. Of the 5.95 million under 5 child deaths in the world in 2015, 1.20 million (20%) occurred in our country. Table 1.1 provides the most recent figures on the key child mortality indices. At 39 per 1000 live births (2016), under 5 mortality in the country is unacceptably high given our stature as an economic, scientific and strategic power. Under 5 mortality rate (USMR) in Japan (3), UK (4), USA (7), Sri Lanka (10), China (11) and Brazil (16) is worth comparing with that of India. Great nations not only have negligible child mortality, but also ensure good health, nutrition, education and opportunities to their children. Almost 60% of under 5 deaths occur in the neonatal period (risk 0 factors n ~c: ·eID !. t eduction in risk factors, increase in protective factors, or intervention during a sensitive period - -- ... -- t Risk factors > protective factors Prenatal Birth Early childhood Adolescence Adulthood Fig. 3.1: Differing trajectories of brain and behavioral development as a function of exposure to risk and protective factors. Reproduced with permission from Walker, et al. Inequalities In early childhood, Lancet 2011 ;378:1325-38 -· Fig. 3.2: Pull to sit; complete head lag In a newborn -.-..! • - - ·---- Fig. 3.3: Pull to sit; no he~d lag at4~th;- Fig. 3.4: Pull to sit; flexes the head onto chest at 5 months The child has complete neck control by 20 weeks (fig. 3.4). This can be ascertained by swaying him gently 'side-loside' when sitting. At this age, the baby loves to play with his feet, and may take his foot to mouth as well. Infant lifts head from the supine position when about to be pulled at 5 months. Ve11tral s11speusio11: The child is held in prone position and then lifted from the couch, with the examiner supporting the chest and abdomen of the child with the palm of his hand. Up to 4 weeks of age, the head flops down (Fig. 3.5). At 6 weeks, the child momentarily holds head in the horizontal plane and by 8 weeks, he can maintain this position well (Fig. 3.6). By 12 weeks, he can lift his head above the horizontal plane (fig. 3.7). Prone position: At birth or within a few days, the newborn turns the head to one side. At 2 weeks, the baby lies on the bed with high pelvis and knees drawn up (Fig. 3.8). At 4 weeks, the infant lifts the chin up momentarily in the midline. The infant lies with flat pelvis and extended hips at 6 weeks (Fig. 3.9). By 8 weeks, face is lifted up at 45° Ag. 3.7:Ventra l suspension; h?od in lirewtth'ffern...r.lt .at 12 .~ Ag. 3.8: Th9 infa nt lies on the b9d wtth .t11gn pel.1s o-d t:re=.s drawn up ct 2 weers (Photo cowe..y: Dr ·.ruc y +~ Ch:Irr.tliJ ' fig. 3.5: Ventral suspension; unable to hold neck In the One With trunk at 4 weeks Ag. 3. 9: The infant Iles wrn fl01 oei.·:s cno e o 31'1090 ..1a ~ 6 w~s (Photo courtesy: Dr Vi}C'V K Cha:cri) Essential Pediatrics - ~~-·~~~~~~~=..:_.:;:;::::;--- . . . ___ .. , (Ptg. ~.10) ,\lld b) 12 weeks, the child can bear weight on tton-.imls with chin .md shoulder off the couch and face at 45(' (Fig. ~. l l). At 6 months, he can lift his head and greater part of lhl' chest while supporting weight on the extended .lrms (Fig. 3.12). Bctwem 4 and 6 months, he learns to roll ovl'r, ,\l first from back to side and then from back to stomach. By the age of 8 months, he crawls (with abdomen on the ground) .md by 10 months, creeps (abdomen off the ground, with weight on knees and hands) (Fig. 3.13). Sittirrg: By the age of 5 months, the child can sit steadily with support of pillmvs or the examiner's hands (Figs 3.14 and 3.15). At first the back is rounded but gradually it str.1ightens (Figs 3.14 and 3.15). He independently sits with his arms forward for support (tripod or truly 'sitting with -· sitlon at 1o months of age (abdomen off Fig. 3.13: Creep po h nds and knees (Photo courtesy: tx ground and weight on Vijay K Charchl) ° Fig. 3 .10: In prone; face lifted to about 45° at 8 weeks Fig. 3.14: Sitting; back rounded but able to hold head at 8 weeks Fig. 3. 11: In prone; face, head and chest off the couch at 3 months Fig. 3.12: In prone; weight on hands with extended arms at 6 months Fig. 3.15: Sitting· b ' · ack much straighter at 4 months I Development ~f\lrt) by the a~ oi &-I months (Fig. 3.16). Steudy S:~~ '"'itho~~ ..my sup~rt gc"'"le.-:illy d~Y"e"fops at around 13 etenth5 Rg. 3. 1 ~. By 10-11 m-0.nths. he can ph"Ot in sitti.-.g r::;.itio.-, ro flay .iround '"'ith toys (Fig. 3.18). 43 Standing amf u ralking: By 6 months, the child can bear almta:ndlng is reflected by the attainment of importani milestones in this sphere. Beginning at around 1 month, the child intently watches his mother when she talks to hir:'l (Fig. 3.37). He starts smiling back (social smile) when anyone talks to him or smiles at him by 6-8 weeks of agf (Fig. 3.38). Itis important to differentiate sodalsmileoom spontaneous smile (smile V\rJthout any social interaclicm), which is present even in neonates. By 3 monfhs, he enjoy3 looking around and recognizes his mnther. By 6 months, he vocalizes and smiles at his mirror image (Fig. 339), and imitates acts such as cough or tongue proirusion. The child becomes anxious on meeting strange;rs (stranger anxiety) by 6-7 months of age. At this ,age, he inhibits to "no". At 9 months, he v;an~s !>ye-bye"' and also repeats any performance that evokes an a;ppredaID-e response from the observers. By 1 year,, he can understand 2 years (train) 4 years (bridge) 6 year;; (steps) Ag. 3.36: Block skills at various ages 3years {ttM-er of 9 bkx::ks) I - 48 ~~~~~~~~~~~~1E~s~s~e~nt~la~IJP~e~d~la~t~rl~c!s----~~~-----=====:==~:::~~~---....._ = Table 3.3: Key so~lal an Age 2 months 3 months 6 months 9 months 12 months I 15 months 18 months 2 years 3 years Fig. 3.37: At l month. the baby showing intent regard of his mother's face as she talks to him 4 years 5 years d adaptive milestones Milestone . . (mile after being talked to) social smile s ther· anticipates feeds Recognizes mo • . angers stranger anxiety ' Recognizes st r waves "bye bye" . alled· plays simple ball game C comes w h en ' Jargon . Copies parents in task (~.g. sweeping) drink toilet; pulls people to Asks for food • ' show toys Shares toys; knows full name and gender Plays cooperatively in a group; goes to toilet alone Helps in household tasks, dresses and undresses . 1e ques t'ions, such as "whereispapa", is. your s1mp . "where . he ba 11 ,,' e tc. By 15 months, he points to ob1ects . I m which d d ·1s m · teres ted . By 18 months, he follows srmp e or ers an . indulges in domestic mimicry (imitates mother sweeping or cleaning). At 2 years, when asked h_e can point t.o 5-6 familiar objects, name at least 2-3 0~1ects. and pomt to 3-4 body parts. He begins to count, identify 1-2 colors and sing simple rhymes by age of 3 years. Much of these milestones depend on the caretaker's interaction and opportunities provided to the child. The left and right discrimination develops by 4 years. By this age, play activities are also very imaginative. By 5 years of age, children can follow 3 step commands, identify four colors and repeat four digits (Table 3.3). Language Throughout the development of language it is the receptive ability and 1111dersta11ding, which precedes expressive abilities. Soon after appearance of social smile at around 6 to 8 Fig. 3.38: Social smile weeks, the child begins to vocalize with vowel sounds such as 'ah, uh'. At 3-4 months, he squeals with delight and laughs loud. He begins to say 'ah-goo', 'gaga' by 5 months of age. By ~nonths, he uses monosyllables (ba, da, pa). Later, he ioms consonants to form bisyllables (mama, baba, dada). ? Fig. 3.39: A child smiles at hlmself In the mirror at 6 months of age Before developin~ true meaningful speech, at around 9-10 months, the duld learns to imitate sounds derived from his native language. At his first birthday, he can usually say 1-2 words with meaning. At 18 months, he has a vocabulary of 8-10 words. Thereafter the vocabulary inc~·eas~s rapidly to aro~u1d 100 words' by 2 years, at which tune 2-3 words are Joined to form simple sentences. By 3 yen~·s, .the toddler continually asks questions and knows lus tull .name. He can give a coherent account of recent expenences and events by the age of 4 years (Table 3.4). I Development Age 49 .. Table 3.4: Key language mllestones Milestone 1 month Alerts to sound 3 months 4 months Coos (musical vowel sounds) Laugh loud 6 months Monosyllables (ba, da, pa), ah·goo sounds 9 months Blsyllables (mama, baba, dada) 12 months 1-2 words with meaning 18 months 8-10 word vocabulary 2 years 2-3 word sentences, uses pronouns" I", "me", "you" 3 years Asks questions; knows full name and gender 4 years Says song or poem; tells stories 5 years Asks meaning of words I Vision and Hearing Adequate sensory inputs are essential for development. Both normal vision and hearing are of paramount importance for child development. The ability to see and hear is apparent even in the newborn. Thereafter maturation of visual and hearing pathways are reflected by specific visual and auditory behaviors. Vision: The best stimulus to check visual behavior is the primary caretaker's face. At birth, a baby can fixate and follow a moving person or dangling ring held 8-10 inches away up to a range of 45°. This increases to 90° by 4 weeks and 180° by 12 weeks. At around 1 month, the baby can fixate on his mother as she talks to her (Fig. 3.40). At about 3-4 months, the child fixates intently on an object shown to him ('grasping with the eye') as if the child wants to reach for the object (Fig. 3.41). Binocular vision begins at around 6 weeks and is well established by 4 months. By 6 months, the child adjusts his position to follow objects of interest, can follow rapidly moving objects by 1 year. Later the child displays more maturity in vision by not only identifying smaller objects but also being able to recognize them. Fig. 3.41: Grasping 'with the eye' ot 3 months Fig. 3.42: Diagonal locallzotlon of the source 10 months or sound at Hearing: Newborns respond to sounds b\· startle, blink, cry, quieting or change in ongoing acth·ih·. Bv 3 to 4 months, the child turns his head towa rds th~ sm~rce of sound. Hearing, may be checked by producing sound 1~: feet away from the t'a r (out of field of vision), .1nd a pa ttern of evolving maturity of he.1 rinb can be obsen·t'' i.•"U1'9 . skills~ soaafization and motor S! . Development 1 early childhood development is likely to be more effective and less costly than addressing problems at a later age. sa 8 Televlslon Viewing and Development Television viewing in younger children has been shown to reta~d language development. It is a passive mode of entertainment and impairs children's ability to learn and ~ead, and . also limits creativity. Children can pick up mappropnate. lan~age and habits by watching TV shows and commercials. Violence and sexuality on television can have a lasting impact on the child's mind. Parents need to r~g~~ate bot~ the quantity and quality of TV viewing, hnuting the time to 1-2 hours per day and ensuring that the content they see is useful. I Chlld Development In Global Perspective According to estimates, 250 million children (43% of all children) under the age of five in developing countries are at high risk of not reaching their developmental potential due to stunting, poverty and disadvantaged environment. Experts have drawn attention towards this critical aspect of care of children, emphasizing the importance of nutrients and nurturing during the critical first 1000 days of life. Nurturing care is care which ensures health, nutrition, responsive caregiving, safety and security, and early learning (Fig. 3.44). Early childhood development programs and other interventions such as breastfeeding, nutrition, interactive play and stimulation, prevention of infections, and learning at home, lay the foundation for learning in school. Effective parent support programs, like the WHO I UNICEF Carefor Child Development and Reach Up and Learn, have been shown to be effective. Useful Internet Resources child development. html http: I I kidshealth.org I parent/ growth/ http:/ /www.nichd.nih.govI http:/ /www.med.umich.edu/yourchild/ http:/ /www.bridges4kids.org/disabilities/SLl.html http:/ /www.zerotothree.org/ I Fig. 3.44: Components of nurturing care Suggested Reading • Council on Children with Disabilities; Section on Developmental Behavioral Pediatrics; Bright Futures Steering Committee; Medical Home Initiatives for Children with Special Needs Project Advisory Committee. Identifying infants and young children with developmental disorders in the medical home: Algorithm for developmental surveillance and screening. Pediatrics 2006; 118: 405-20. • Black MM, Walker SP, Fernald LCH, et al; Lancet Early Childhood Development Series Steering Committee. Early childhood development coming of age: science through the life course. Lancet 2017; 389(10064): 77-90. • Britto PR, Lye SJ, Proulx K, et al; Early Childhood Development Interventions Review Group, for the Lancet Early Childhood Development Series Steering Committee. Nurturing care: promoting early childhood development. Lancet 2017; 389(10064): 91-102. • Richter LM, Daelmans B, Lombardi J, et al; Paper 3 Working Group and the Lancet Early Childhood Development Series Steering Committee. Inves ting in the foundation of sustainable development: pathw ays to scale up for early childhood development. Lancet 2017; 389(10064): 103-18. • Nair MK, Nair GS, George B, et al. Development and validation of Trivandrum development screening chart for children aged 0-6 years. Indian J Pediatr 2013; 80 Suppl2: S24S-55. -, Developmental and Behavioral Disorders Biswaroop Chakrabarty • Sheffali Gulati start walking from sitting and standing without support. Dissociation is defined as the acquisition of develoi:mental milestones in various domains at differing rates, e.g. isolated speech delayed speech delay with normal development in other spheres, as in patients with congenital hearing loss. The cognitive growth and behavioral phenotype of an individual chiefly reflect the growth and development of • the body, particularly the brain, during early years. Factors like nutrition, environment and social and emotional milieu play a significant role. Etiology GLOBAL DEVELOPMENTAL DELAY, INTELLECTUAL DISABILITY An etiology can be defined in 70% patients with developmental disorders (Table 4.1). In developed countries, antenatal factors predominate; whereas in the developing world, perinatal and postnatal factors are more common. Patients with developmental delay may have various comorbidities depending on the etiology (Table 4.2). Depending on the etiology, the yield of diagnostic tests varies from 10 to 80% (Table 4.3). Global developmental delay is defined as delay in acquiring milestones in two or more of the following domains, namely gross and fine motor, speech and language, cognition, socio-personal and activities of daily living. Above 5 years of age, the term intellectual disability is used, replacing the previously used term mental retardation. The estimated prevalence varies between 2.5 and5%. Management A child with developmental delay is managed by a multidisciplinary team comprising of a pediatric neurologist, geneticist, psychologist, psychiatrist, occupational and physiotherapist, speech therapist, audiologist, ophthalmologist, nutritionist and social worker. Early intervention is important to achieve the maximum potential Developmental Deviance and Dissociation Deviance is the acquisition of milestones in a sequence that is different from usual. For example, children with cerebral palsy may show early standing with support secondary to increased extensor tone. This may also be seen in normally developing children; children may not crawl and directly / ! -~.- ·-~.':··~- 'Antenatal -. '.. Perinatal, neonatal Postnatal -I ·i&bii 4:1: Etiology of de;eiOp~-~ntal delay acc"C;~cii~g-to' the t ime ~·insult r --· . ,~~ - , • .... r· ··1 Syndromes (fragile X, Rett syndrome) Chromosomal disorders (Down syndrome) Cortical malformations Intrauterine infections Inborn errors of metabolism (aminoacidopathy, organic acidemia, mitochondrial disorder u disorder, disorders of glycosylation) • rea eye1e Teratogen exposure Neuromuscular disorders (predominantly motor delay) Hypoxic ischemic encephalopathy Kernicterus After meningitis or encephalitis Hypoglycemic brain injury_ Hypothyroidism After head trauma· ... .- ' ·t • 1: Deficiency of vitan:iin B12 , iodine or B,; toxins (lea.d) 54 ~ .l~ :. • • ~. - I Dovolopmontol ond Bohnvlornl Disorders 4 Toblft · •2 : Comorbldltlos In potlonts with dovolopmonti f1t1ordoro ilVOIOJlmontnl do/try, lntolloctm1/ dlsnb//lty .'1Ji1Urt)S Vrlslodrl' nlmormnlltlos, homing lmpnlrmont, spoocll disorders ()C\ no problorns Oohnvloml problems, sloop dlsturboncos ontrnoturos, bod soros Awlsm spoctrwn dlsordor Solwros 1:nodlng problom Etlopolhogenesls The pathogenesis of autism is not clear. Abnormalities in neural connectivity nnd migration, dendritic and synaptic morphology and functioning of mirror neurons have been implicated. Genetic causes such as fragile X syndrome, tuberous sclerosis, Angclman syndrome and metabolic dlsenscs like phenylketonuria and hypothyroidism account for 10% cases. Diagnostic Approach Ootmvlorol problems: Aggrosslon, lmpulslvlty, hyperactivity, l11attont1011, sloop rolatod problems Gognltlvo lmpnlrrnont Attontlon doflclt hyporactlvlty disorder Sloop problems Enurosls, oncoprosls; obesity Looming dlsabllllty Oohnvlorol cornorbldltles: Autism spectrum disorder, tics, conduct dlsordor, delinquency Anxloty, bipolar Illness Spoclflc learning dlsab//lty Epilepsy Attontlon deficit hyperactivity disorder, tics Obsosslvo compulsive disorder Tic disorder Obsessive compulsive disorder; anxiety, depression Attontlon deficit hyperactivity disorder Loaming disability Autism spectrum disorder Autism Spectrum Disorder Autism spectrum disorder (ASD) is characterized by the trind of qualitative impairment of social behavior, communicntion (verbal nnd non-verbal) skills and associated stereotypic and restrictive behavioral patterns, with onset before 3 years of age (Table 4.4). The estimated global prcvnlence is 1 to 2%. The Dingnostlc and Statistical Manual of Mental Disorders (DSM) IV required fulfillment of a minimum number of symptoms listed in the three domains (social interaction, communication and behnvior) to label a child as having an ASD. Guidelines, according to DSM 5, have combined social interaction and communication domains into one. Thus to be labeled as having an ASD, a child has to fulfill a minimum number of symptoms in two domains (social interaction and communication, and behavior). Common comorbidities are shown in Table 4.2. Management The chief therapy is behavioral intervention; the role of pharmacothernpy is limited (Table 4.5). Attention Deficit Hyperactivity Disorder Attention deficit hyperactivity disorder (ADHD) is the most common ncurobehavioral disorder of childhood. Its prevnlence in India was estimated at 1.3 per 1000. The American Academy of Pediatrics recommends evaluating any child between 4 and 18 years of age for ADHD, if he or she presents with academic or behavioral problems with symptoms of inattention, hyperactivity and impulsivity (Table 4.4). Diagnosis ADHD is diagnosed clinically. The DSM 5 criteria require fulfillment of predefined number of criteria in inattention, hyperactivity and impulsivity domains. The onset of symptoms can be up to 12 years of age and they should Table 4.3: Diagnostic tests In evaluation of developmental deiay · ··- Investigation Neurolmaglng (MRI preferred over CT) Metabolic tests (ammonia, bicarbonate, lactate, sugar; blood TMS; urine GCMS) Genetic studies (cytogenetlc studies, karyotyplng) Thyroid function tests; blood and urine lead; mlcronutrlent l~vels Electrophyslologlcal tests os - Indication \. - . ~ .. Specifically If abnormal head size and/or abnormality on neurological examination · Clues on history or examination (recurrent encephalopathy, vomiting, seizures, regression of milestones, organomegaly, cataract, retlnopathy) .j Developmental delay without a known cause, Irrespective of dysmorphlc features - '. " ' : If Indicated cllnlcally .., ... • , •• ' .. - •• J Where Indicated: Electroencephalogram, visual evoked responses, bralnstem evoked : response, audiometry, nerve conduction studies, electromyography · '. _. . ., .~ -·~ ._.; ! 1 MRI: Magnetic resonance Imaging: GCMS: Gas chromatography mass spectrophotometry; TMS: Tandem mass-spectrophotometry - - . . .- -. I ., ~ . - ....- I 56 ~~~~~~~~~~~~~E!ss~e~n~t~la~l£P~e~d~la~tr~lc~s~-----------------~~-=~-=~-----.._ . . . 'fie learning disability Table 4.4: Clinical features of autism, ADHD and speci Disorder Salient clinical features Autism spectrum disorder Onset before 3 years of age . ·1 Impaired verbal and gestural communication Defect in social and emotional reciprocity Stereotypic and restrictive behavioural patterns Attention deficit hyperactivity disorder (ADHD) Onset up to 12 years of age Present in at least 2 different social settings r ing Interfering with social, academic and occupational fun~ ion mistakes, easily distracted) Inattention (difficulty sustaining attention, prone to care ess Hyperactivity (often on the go, fidgety) lmpulsivity (intrusive, interruptive, cannot wait for turn) Specific learning disability• Dyslexia (difficulty in reading) Dysgraphia (illegible handwriting, spelling mistakes) Dyscalculia (difficulty performing simple calculations) "Preserved Intelligence, vision and hearing Persistent for at least 6 months despite interventions targeting specific disability preserved cognition, vision, hearing and adequate opportunities (Table 4.4). It affect~ 5-15% of s~~ool-go~g children. Dyslexia accounts for 80 Yo of all specific learrung disabilities. These disorders are probably caused by functionally disrupted networks in the cerebral cortex with intact anatomy. Table 4.5: Pharmacotherapy for autism spectrum disorder Medication Indication Antipsychotics Anxiety, aggression, repetitive (risperidone, olanzapine) behavior Methylphenidate Inattention, hyperactivity, impulsivity Alpha-2 agonists (clonidine, atomoxetine) Hyperactivity Melatonin Sleep-related problems Iron supplements If deficiency is documented Diagnosis Features suggestive of specific learning disabilities include reading slowly and incorrectly, skipping lines while reading aloud, making repeated spelling mistakes, untidy /illegible hand-writing with poor sequencing, and inability to perform even simple mathematics, incoherent to the child's intelligence level. The DSM 5 diagnosis of SLD requires fulfilling a predefined number of criteria in reading, writing and arithmetic skills and these impa~rments should persist despite in~erventions targeting the specific disability for at least 6 months. be present in at least two different settings interfering with the social, academic and occupational functioning of an individual. The associated morbidities are summarized in Table 4.2. Management The cornerstone of management is psychotherapy tailored for each individual and the family. In patients with inadequate response to psychological interventions, drugs like methylphenidate and atomoxetine are indicated. Management Management revolves around remedial education with active participation from both school and parents. Specific Learning Disability Tic Disorder and stereotypies Specific learning disability is defined as a persistent impairment in reading (dyslexia), writing (dysgraphia) and/ or arithmetic (dyscalculia) skills in an individual with Tics are abrupt onset f t as' paroxysmal/ non-rhytlunicmotor or vocal manifestati hi ons w ch may be simple or complex 1 -- ·- :r;i>,;-i.5;-cof!Jmon-ti~i;chi1ci~~~~--:-- --- - --~- - -:-~---~--::-. .-~~;;:-'. Motor tics Simpie Eye blinking, neck jerking, shoulder shrugging Complex : Foot tapping, echopraxia (imitating others), copropraxia (obscene gestures) • .. Vocal tics Simple • Throat clearing, sniffing, coughin .g . Complex ••• · •• • - , . ~ ' ·,..:. 'it- ' ' '" .: , . '-'··:. .·~-t! ,,,-n_i.; ~.-· .: -. _ ,t ·· - ~,;;;~- # J.• .. ~, ~ .' :· ' •'(, . ·...' '.· · :- ,:. » '-' ~ 1 ~.... ~ •' · - ~, ~-, ... 1· ·' ,1 :.,.JI .._;:.-.. .. · .. · ... ~' 1 •• Words out of context c~prolar ' ... : . . '-· ._, ,· ~-·· .. , . . . :1·. . - . (repeating heard phr~ses or la (obscene words), echolalia ; ..... or phrases) .. ,. ,. .)YOrds), palilalia (repeating own words • ' .:.;:. _· ; ':-.1.: v ':-~.:;- .. ,. ·.· ' .. , • . • ·,_,_;.:.,_,. :.'. • . •. -~,,_:. ''\. ...y ! Developmental and Behavioral Disorders (f:iblc 4.6). The a 0 f . onset is 4-6 years with peak at 10-12)·curs 'and s 1·gn1"f~e leant attenua rion b y 18-20 years. Th e pr~valence is around 10-15% with higher rate in boys. Tourette syndr . 18)"l.'ars of a e ome is characterized by onset before . t g ' presence of both motor and vocal tics and . . p1o•1-s1s ence beyond 1 c.m be associated . year, md~dmg the waning phase. Tics . . WI th neurological ailments like Huntington ;m d W i1son disease o . th . . . t>diatric aut . ' r wi parainfectious illnesses, e.g. 0 unmuneneurops chi tr" dis d P · d . . with strcpt Y a ic or ers assoaate . . ococca1 infection (PANDAS). lt is 111'Portant to differentiate stereotypies from tics. Alth oug 11 stereotypi . . vocal and motor .f . es may h ave Slffillar ma ni estations l · . ' c assica 11 y they are rhythmic and dts t.rkact~ble, and usually remain stable over a time period un 1 e hes which may evo1ve temporally. Stereotypies' usua 11 Y ~ave an early onset (before 3 years of age) and along wit~ neurodevelopmental disorders, may affec~ normal culdren, as well. 1 Management The . es~enti~l component is behavioral therapy. Medications hke haloperidol and clonidine are considered i~ situ_ations w.here the tics are socially and functionally d1sablmg despite adequate behavioral therapy. Eating Disorders This group consists of primarily two disorders, anorexia nervosa and bulimia that chiefly affect girls and have in common a disturbed body image perception. Anorexia nervosa usually affects 15--19 years old girls. Characteristic features are an intense fear of becoming fat even though the child is underweight, with body weight 14 years . . . . . ~.-~/' ~.-::-:,:. :\":; • · •· h. tels : .. L .,.· ' · , .. ·.- · · · -" ::":" ~·:!.,.:,_ ··; t L-0-~~p~~f!Efr~~J.'.::~.:.i:·L.t'_ . . . ...i.:: -~·,;.3.,::_., J;_~'~"""'' -··-6-.f.•.·~,·-~< ,.__.. -:'1 ~ hai'.arifous: ',.. ·? ' : .• _ .• Adolescent Health and Development -.- -......... ·-~~-.,.- · ·~··Table. 5.3: Chockl.ist for adolescent health vie It ·-- History from parents and adoles~ent 65 - - -... -)ro .... History of proeentlng problems Paronto! concerns on growth, development Academic success; school absenteeism Dlot history Including calclum, protein and Iron intake; junk food Menstrual history: sloep problems History on separate questioning of adolescent Emotional probloms; rolatlonahlp with family and peers Outlook towards physical and sexual changes Involvement In relationship or sexual activity Awareness about safe sex and contraception Specific problems related to sex organs Tobacco or other substance use Counsel and clear doubts on sensitive topics History on separate questioning of parents Relationship with family Level of communication on sensitive matters Physical examination Anthropometry Blood pressure, markers of obesity, acanthosis Sexual maturity rating Signs of malnutrition, anemia and vitamin deficiencies Signs of skin and genital infections Level of general hygiene Signs of trauma; abuse Signs of drug abuse or tobacco use Counseling Nutritional intervention Hygienic practices Building rapport between parents and adolescent Providing information and sources on sex education Investigations Hemoglobin level Blood sugar, lipid profile Genital swabs Ultrasound of ovaries Referrals Counselor Dietitian Psychiatrist Gynecologist Voluntary and confidential HIV testing Social services, child protection agencies, support groups Establisliing rapport: Being empathetic and nonjudgmental is the key to effective communication. Direct questioning of the adolesce~t is as.impo~ta~t as questioning the parents. Beginning the. mterv1e~ with icebreakers, ~se of open-ended non-sensiti~e q~estions and then movmg to sensitive/targeted questions 1s helpful. Confidentiality: One may need to interview a young patient separately, as he/she may not want to disct~ss sensitive topics in the presence of pnrents. While examining the genitalia, the doctor can ask patient's preference for presence of their parent ins ide the examination room. A boy may prefer his parents standing outside the exam room, whereas a girl may find it comforting, if her mother accompanies her during the examination. Consent: For a child who is less than 12 years, consent for examination or medical/surgical procedure is obtained from the parent or guardinn. While an adolescent aged 12-18 yenrs can give consent for examination, consent for medical/ surgical procedure can be g iven only after 18 yen rs. This also includes consent for medical termination of pregnancy, blood and organ donation. N11tritiu1111/ i11tcn1t•11tic111: Improving the nutritional status of ndolescent girls helps in two ways. It breaks the cycle of malnutrition and low birth weight babies, and prevents long-term complications of the latter in future generations.Providi11g l1c11tlt i11formatio11: The adolescent health visit is an excellent opportunity to talk to the parents and their adolescent about the pubertal changes. It is likely thauhey I 66 have not received any formal sex education in school and need to be provided correct educational resources for the same. Refemi! to social service:>, psycl1ologicnl cva /11ntion attd s11p/)orl: National Commission for Protection of Child Rights Act 2005 considers a person below 18 years as a 'child'. It is mandatory for a health care provider to report all cases of child abuse (even suspected) to the Chairperson of the Commission; the complaint can be lodged online or in w riting. Doctors are protected in case of erroneous reporting but punishable, if they fail to report. Adolescents with special needs or victims of any kind of abuse need social and psychological support. Adofcsce11t-fricndly healtlr services: Adolescents have diverse problems and special needs. The services include provision of reproductive health services, nutritional counseling, sex education and life skill education. Confidentiality, easy accessibility, friendly attitude and quick comprehensive health care delivery have made a pos itive impact on adolescent clients. 'Adolescent reproductive and sexual health' has been identified as a key strategy under RCH II programme. Adolescent friendly clinics are functional at many centers in the country. Box 5.1 lists the key services and interventions that should be provided for comprehensive care for adolescents. Management of sexual violettce: This includes the following measures: i. Forensic examination and collection of blood or body fluid samples by trained staff. ii. Care of the injuries. iii. Prophylaxis against pregnancy: Two doses of levonorgestrel 12 hours apart, first dose being given within 72 hours of intercourse. iv. Prophylaxis against sexually transmitted infections includes a single oral dose of azithromycin 1 g along with cefixime 400 mg and metronidazole or tinidazole 2 g, protects against syphilis, gonorrhea, Chlamydia and Trichomonas. Hepatitis B vaccination is recommended, if the person is not previously immunized. v. Prophylaxis against HIV requires referral to the nearest integrated counseling and testing center. vi. Psychological support includes counseling and referral to a psychiatrist. Informing concerned authorities or social services is important as patient may need shelter and legal help. A teen may not be willing to disclose this assault to his parents. Childline (1098) is a support service provided by Government of India focussed on child care and protection. Protection of Children from Sexual Offenses {POCSO] Act 2012: The POCSO Act protects individuals below 18 years from sexual offense or harassment of any form, be it physical or pornographic. It also explicitly states that an rm::::§.m.Mi • :rztJliWfl"!\'1• 1·00~~ ~ flealtl1y • '• • • • lifesh;fc ' Healthy food Exercise and Yoga No to tobacco, alcohol, drugs Safe conduct on road Vaccines • Papilloma virus, rubella Anemia . . · detection · and management of anemia / especially • Prevention, for adolescent girls Sexual health • • • • Sexuality education Menstrual hygiene Marriage after 18 years, childbirth after 20 ~ears Counseling and services for comprehe~s1ve sexual and reproductive health, including contraception Mental health • Supportive family; counseling and peer/family support in anxiety, depression • Prevention and management of hazardous and harmful substance use , • Prevention of suicide and management of self-harm/suicide risk Violence prevention • Prevention and management of unintentional injury • Prevention of and response to sexual and other forms of gender-based violence · · Co11111111nicable and non-comm11nicable diseases 1 • Prevention, detection and treatment of communicable and non-communicable diseases I Preparing for ad11lthood • Parenting skills, responsible husband, wife and father event of abuse must be informed to legal authorities; failing which, the knowing person [including the health care provider] is liable to legal actions including imprisonment. Contraception: A pediatrician should advocate for abstinence and delayed initiation of sex to adolescent patients. In case the adolescent is already sexually active, condom seems a better choice compared to other methods. Adolescents with disabilities or mental retardation are wrongly assumed t.o be at low risk for STis and pregnancy. Parents of such children need to be counseled regarding these issues. · · .. Adolescettt imm1mization: India has i~w ~overage for boos~er ~oses of TT at 10 and_.16 years: Papilloma virus ~~c~1~e is recommend~~ for perip~bertal girls (before m1hahon of sexual activity) for prevention of infection with human papillomavirus cervical cancer. Parents need to be co~seled. !}\oroughly as the principle berund . giving the vaccine might alarm them (Table 5.4). " . and ; I - '. .'-. ·.: f ~· • I. ,,_ ..'" I - Adolescent Health and Development 167 - . '· ·.-.-~---~~~.T~ble 5.4: lmmunlz;\k;~ci~;l~g-;-dole;cence ~~--.-~·-·or.-- ~.- ·-~r:...:-z.i) T~tanus and dlPhth'E;ria-t~~oid·~ ·and ac~llui~r pertu.ssi~ - - - 10-12 years, and 'every 10 years th~reafter -~· (Tdap) vaccine ITT at 10 and 15 years as per Universal Immunization Program] • Papillomavirus Influenza Catch-up vaccination is discussed in Chapt~r 1o i 2 doses, If given between 9 and 14 years 3 doses, If given beyond age 15 years Annually Transition to adult care: With better medical care, a large ~umber of chronically ill or disabled children are surviving into adulthood. As the problems of these children are diverse, they need multidisciplinary care even in their adulthood. Transition to adult care is not mere transfer of the case to a different physician. It is a gradual and planned process; keeping in mind the abilities of the child to participate in self-care, taking responsibilities and decision making. The age at transfer is not fixed; a window of age 14-18 years is used in some countries for a gradual transfer. GOVERNMENT INTERVENTIONS IN ADOLESCENT HEALTHCARE Kishori Shakti Yojana and SABLA Yojana aim to provide health, nutrition, education and vocational skills to adolescent girls. National Youth Policy believes in youth empowerment through education. Recognizing the contribution of adolescent care to maternal and child health, National Health Mission now follows Reproductive, Maternal, Neonatal, Child and Adolescent Health (RMNC+A) approach. Under this program, weekly iron and folic acid supplementation (WIFS) program provides 100 mg of iron and 500 µg folk acid with biennial deworming to all adolescents attending government schools. I Suggested Reading 1. National Family Health Survey [NFHS3, 2005-6] and [NFH.54, 201516]. International Institute for Family Survey, Mumbai. 2. WHO Media Centre Fact Sheet 2014. Adolescents: health risks and solutions. 3. Contraception and Adolescents: Committee on Adolescents, Pediatrics 2007;120:1135. 4. National Guidelines on Prevention, Management and Control ofRTis/ STis. Ministry of Health and Family Welfare, Govt of India, 20CJ7. 5. Dietary Guidelines for Indians [Second Edition]. National Institute of Nutrition, 2011. 6. Juvenile Justice Act 2015. The Gazette of India, Ministry of Law and Justice. .... _ .-: . . ·l :~ ' :- Chapter 6 Fluid and Electrolyte Disturbances Kamran Afzal cellular volume depletion. The inter~titial space, especi.ally in skin and connective tissue, is an 1mportant reservotr of COMPOSITION OF BODY FLUIDS The major component of body mass is water. The contribution of total body water to body weight varies with age, lean body weight and adiposity. Total body water (TBW) as a percentage of body weight declines from as high as 90% in early fetal life to nearly 75-80% at the time of birth. Ther~after, it declines progressively to 60% by the end of the first year and remains so till puberty. Since adipose tissue has lower water content, therefore, adolescent females and overweight children have lower TBW as a percentage of body weight. Total body water is distributed in two major compartments, two-thirds is intracellular fluid (ICF) and one-third is extracellular fluid (ECF). Nearly one-fourth of ECF is distributed in the intravascular space (plasma water) and th~ remaining in .t he extravascular (interstitial) space (Fi~. 6.1)'. The relative size of the two main compartments vanes with age. Increase in extracellular fluid volume contributes to the increased TBW in neonates, especially preterm babies. The interstitial fluid component of extracellular fluid is actually a matrix, a collagen/gel substance that allows the interstitium to provide structural rigidity during

extraInterstitial fluid extracellular fluid. Water Balance In the steady state, water balance represents the difference between water intake (including that generated from endogenous metabolism) and water losses (Fig. 6.2). Much of the water output involves obligatory losses in the urine, stool and, by evaporation from the moist surfaces of the skin and respiratory tract (insensible losses). The kidneys are the major regulators of water output with nearly twothirds of daily water losses being urine. The obligatory renal water loss is directly related to solute excretion. The evaporative losses play an important role in thermoregulation. In contrast to these insensible losses sweat which is hypotonic (Na+concentration 35 to 65 mEq/ L) is actually 'sensible loss' . It also contributes to thermoregulaho~ and may reflect the majority of total dail loss of water m presence of high ambient temperatu:es or when endogenous heat production is enhan d / 'th exercise or fever. ce as w1 ~hanges. in sodium concentration in the extracellular fluid ·aredlmked to extracellular fl m'd vo1ume and are · associate with dysregulated water b 1 for volume regulati . . a ance. The effectors on are pnmanly renin . . aldosterone system and a tna . . 1natnureti -ang1otensmtid b f which affect Na+ excretion. Besides this r~ pep . e, oth o water is made possible b . gulation of body, factors, including vasop/ i~terplay of multiple other minergic receptors ,.., aedssm, prostaglandins, dopa' ....- renergic . ~eceptors, thirst mechanism and intrinsic ren 1 a properties. Electrolyte Composition of BodY Compartments The extracellular fluid compartm ~n~~ontains high concentration of sodium, chloride Potassiurn, organic phosph a; icarbonate (Fig. 6.3). Intracellular fluid predominant ICF osmoles B a es and proteins are the Fig. 6. l: Body composition. Nearly 60% of the body wel ht Is and ICF distribution, the. se:~':se of variability in ECF 1wo-thlrds Is Intracellular, while the necessarily reflect the total bod concentrations do not ' w ch Is distributed between the Interstitial and Intraelectrolyte. Permeability to ions ~ac?nt~nt of a particular vascular compartments in 3: 1 ratio .68 nes m each organ with ~~{' Ofh~~ rest~ extrac~lular - Fluld nncl Electrolyto Dlaturboncos Input Water Intake Is regulalod by osmoreceptors In hypothalamus I01111m1 I I ee - J Wotor lnt11ko: fluid (60%), rood (30%) Urlno (00%) Stool (0%) Swoat(4%) Wotorol oxldnllon (10%) lnlm1ltilo loll6 (20%) nkln, lunos Wotnr IOI!!! hi rnguln tod by 11nlldlurnlln horrnono lrom flOGtorlor pllullory I l\ Fig. 6.2: Balance of water Intake a nd 1osses maintains normal plasma osmolallly. Only water lntako and urinary losses can be regulated 140 ' 140 ~·····~ ' lntrncollulnr Plasma 120 104 100 _, ::. 80 0 E 60 E 40 20 0 fig. 6.3: Electrolyte composition of Intracellular and extracellular fluid compartments the brain having the least and the liver the most permeability. However, water readily crosses cell membranes to achieve an osmotic equilibrium between the two compartments. The balance and appropric1te distribution of fluid within these spaces is maintained by the colloid oncotic pressure, membrane p~rme~bility a.nd ~1ydrost~tic pressure. Plasma and interstitial flmd are nch m protems, which determine plasma colloid oncotic pressure. Osmolallty Osmolality (expressed as milliosmoles pe.r kilogram .of water, mOsm/kg) is the solute concentration of a flm~. Changes in osmolality can produce grave neurologtc consequences and even death, primarily due to water movement into and out of the brain. To prevent this, the plasma osmolality, which is primarily determ.i ned by the plasma Na+concentration, is normally maintamed closely between 1 and 2% of the normal (285 to 295 mOsm/kg) by appropriate variations in ~ater intake and ~ater excretion. This regulatory system ts governed by different osmo· receptors in the hypothalamus that influence both thirst nnd the secretion of nntidiurl'lic hormone (ADH) (Fig. 6.4). Plnsmn osmolnlity cnn be mcnsured directly using osmometers, ns wc11 ns eslimntcd lndil'cctly ns follows: ' l glucose blood men nltmgcn Plnsmn osmoInIlly"' 2lN n + l.S 18 + Mensmed vnlucs nrc gcncrnlly higher thnn cnlculntcd vnlues by up to 10 mOsm/kg nnd this difference is cnlled osmolnl gnp. lncrcnsc In osmolnl gnp mny occu1· due to incrensc in unmcnsmcd osmolcs. Normal Maintenance Fluld and Electrolyte Requirements !he m~nrml mnintcmmcc wntcr requh·cmcnt is eqtml to the ms.ens~blc nnd urinnry wntcr losses. Hollidny nnd Scgm· gutdclu1cs (1957) cnkulntc mnlntennncc fluid volum~s to mntch electrolyte-free wnter requirements from esthnntes of water of evnpomtion (hcnt dissiplltlon) nnd cnloric exp~ndlturc (hent productloi\). They cstlmnted n dnlly sodmm requirement of 3 mEq/kg, pohlssium nnd chlmld~ 2 mEq/kg ench nnd dnily glucose rcqulrement l\S 5 g/kg 70 Fluld loss t lloh osrnolnrlty lltlmulntes osmorocoptors Decrease In blood volume Hypothalamus Thlnlt Anterior pituitary ADH secretion I 1 + Decrease In renal blood now Free water teabsorptlon In distal tubules and collecting ducts fl/i~ Anglotensin I J_ Angiotensinogen ~ Anglotensln·converting enzyme Angiotensin II +. Aldosterone release ~ Sodium and water retention Water Intake reduces osmolnrlty '+ Renin Decrease In GFR Adrenal .J Restored blood volume Fig. 6.4: Regulation of sodium and water balance . . . Table 6.1: Maintenance fluid requirement in healthy children Body wet'ght Per day Per hour 0-10 kg 100 mUkg 10-20 kg 1000 ml for first 1O kg + 50 mUkg for each kg beyond 1O kg 4mUkg 40 ml + 2 mUkg for each kg beyond 10 kg >20 kg 1500 ml + 20 mUkg for each kg beyond 20 kg 60 ml+ 1 mUkg for each kg beyond 20 kg based on the electrolyte composition of human and cow milk nnd rcconu11cnded 30 mEq/L sodium chloride (saline) for maintenance fluid in children. Maintenance IV fluids in nn unwell child may be initiated with 0.45% normal saline along with 5% dextrose and 20 mEq/L of potassium chloride (provided urine output is adequate) . This composition may be modified according to the clinical state. The guidelines for maintenance volume (Table 6.1) assume average calorie expenditure in a healthy child. Fluid requirements change considerably in different clinical conditions (Table 6.2). IV fluid with osmolality lower than plasma osmolality can cause movement of free water from plasma to red blood cells leading to hemolysis. Therefore, infusing plain I Table 6.2: _Condltlo~~ th~talter"~alnten~~e _fluid needs • Increased fluid requirement Decreased fluid requirement Fever (10-15% per 0 c above 36°C) Radiant warmer, phototherapy · Bums, sweating Physical activity; hyperventilation Dlarrh~a, vomiting folyuria, renal . . concentrating defects ·' Very low birth weight babies (large su"rface a_rea) . 1 • Oligurla or anuria Humidified ventilator or incubator Hypothyroidism I • ....-. !.- • , • ,...·. • •'~~ ' j .' - - - ~ ..i: ••, J.,. • ' .1 ' 5% dextrose in water or 0.2% or 0.45% saline (without dextrose) should be avoided. There is considerable evidence that use of hypotonic fluids in sick hospitalized patients increases the risk of hyponatremia several fold. Normal saline (0.9%) can be safely administered in standard maintenance volume without risks of hypematremia or fluid overload, except in patients who are fluid restricted (e.g. congestive heart failure, liver and renal ~ailure) ~n~ ~hose with renal concentrating defect (e.g. diabetes. ms1p1dus)'. ~ypotonic fluid should only be used to achieve a positive free-water balance as in replacing renal or non-renal loss of electrolyte-free water. The ideal volume for maintenance fluid is debated. Conventional calculation using weight-based formulae often lead to overestimation o~ electrolyte-free water, and excess free water retention that predispose to hyponatremia. Therefore, it may be prudent to restrict maintenance fluids to 40-60%, especially in critically sick children. Fluids should be limited around 400 mL/ m2 in renal failure with oliguria. There is no single maintenance intravenous fluid which is suitable for all clinical scenarios and maintenance fluid prescriptions should be individualized. All children receiving IV maintenance fluid should be monitored with daily weight fluid balance, clinical and biochemical parameters in 0 ;der to maintain homeostasis. Additionally, maintenance IV fluids do not replace daily nutrient requirements and provide only 20% of daily calories (enough to avoid starvation ketoacidosis and diminish protein degradation). 71 Fluid and Electrolyte Disturbances r • ..Table 6.3:. Clinical assessm~nt of dehydration No dehydration Decrease In body weight 6% in older children Lethargic to comatose Cold, mottled; tenting Unable to drink Skin color and elasticity (turgor) Sunken eyes Normal Increased Cool, pale; mild delay in turgor Normal Sunken Very sunken Mucous membrane Normal Dry Pulse rate Slightly increased Blood pressure Normal 2-3 sec Normal Urine output Slightly decreased Very dry Tachycardia >4 sec Normal or low Oliguria, anuria Capillary refill 3-4 sec Normal Decreased DEFICIT THERAPY The ~egr~e of volume depletion is assessed by physical examination (Table 6.3). The process of hypernatremia or hypertonicity decreases the severity of physical signs of volume depletion. All fluid lost should be replaced daily to maintain euvolemic state. Steps for providing fluids and electrolytes to volume depleted patients are: • If the patient shows signs of shock, compensated shock or features of severe dehydration (Table 6.3), rapidly infuse isotonic fluids to restore intravascular volume. This is done by infusing 1 to 3 fluid boluses of isotonic saline or Ringer's lactate, 20 mL/kg body weight. . • Provide fluids to replace calculated/observed volume deficit. This is calculated as volume at the rate of 10 mL for each percentage weight loss. For example, in patients with moderate (some) dehydration, which is on an average 7.5% weight loss, the replacement volume is 75 mL/kg body weight. If the pre-dehydration weight is known, the volume of fluid needed is 1 liter for every kg of weight loss. • Provide fluid and electrolytes to replace the amounts lost in normal daily m etabolism (maintenance fluids) . • Provide enough fluid to replace ongoing losses of various body fluids (Table 6.4). While current literature does not advocate use of one type of fluid over another, there is a growing concern of hyperchlorernic metabolic acidosis ~ith fluid resus:itation wi_th normal saline. Balanced flmds, such as Ringer s 1 .·Table.s:4~1ectro~7onipo~it!or~ b9dY flu.ids , . .. · I(+ · · ·.: Lo~~es': · ~... tia~ (m£q!LJ , 1 , 60-100 Gastric ·Small intestine 80-140 · Colon · Pancreas . Diarrhea · ... Severe dehydration Some dehydration 5-10% in infants; 3-6% in older children Irritable ~~-- " . ·-" ·· (rn£q!LJ . 5-20 5-15 60 30 135-145 . '5-10 10-90 ·· ..:· .1~o - er: ,· .l Hco3- ! (m£q!L) 90-130 . (f!1£q/LJ 1 0 90-140 40 . 70-90 - 40 15 95-, 20 .. 90-130 "· 4.0_'. ~ ..._J lactate, that mimic plasma composition better than normal saline may be considered, especially in the setting of acidosis. I SODIUM Physiology Sodium is the most abundant ion of the extracellular fluid compartment and is critical in determining extracellular and intracellular osmolality. Normal serum sodium concentration varies between 135 and 145 mEq/L. Extracellular sodium balance is determined by sodium intake relative to sodium excretion. Daily sodium requirement is 2 to 3 mEq/kg body weight although intakes are generally well in excess. The requirement varies with age. It is nearly two- to threefolds higher in term and very low birth weight preterm babies, a reflection of immaturity of renal tubular function and higher requirements for growth. Adult requirements decrease to 1.5 mEq/kg/ d . Urinary sodium excretion represents the majority of sodium losses and approximately equals the daily intake of sodium. Fractional excretion of sodium is generally less than 1% of filtered load. Extrarenal sodium losses can be significant v ia profuse sweating, bums, severe vomiting or diarrhea. A fall in blood pressure, decrease in sodium delivery to the macula densa, or sympathetic stimulation may activate the renin- angiotensin axis, generating angiotensin II. This results in increase in blood pressure and sodium retention caused by enhanced aldosterone secretion. The effective circulating volume refers to that part of the extracellular fluid that is in the arterial system and is effectively perfusing the tissues. The effective circulating volume usually varies directly with the extracellular fluid volume, and both are proportional to total body Na+ stores .. As .a :esult: the regulation of Na+ balance (by alteration in its urinary excretion) and maintenance of effec.t ive circulating volume are closely related. Sodi~ loading tends to produce volume expansion, whereas loss leads to volume depletion. · · · ' ·· ' 7~ ~~~~~~~~~~~~~E~s~s~e~n~t~ia~l~P~e~d~ia~t!rl~c~s~~~~~~~~-~~~~~~~~~~~-/ .. an d confusion . Ad va nced nausea, vom1tmg, lethargy . d ticate p o:xccssiw loss of sodium from eX\'.''::siY,~ ::wealing, \'omiti ng, d iarrhea, burns and the ;hhninstr.\liut\ of diuretics (fable 6.5). The most common C-1\l::e tit' hypon.ltremia, however, is not a deficiency of tnl.ll body sodium, but an excess of total body water, as in the syndrome of inappropriate antidiuresis (SIAD). Sli\D is seen in association with pulmonary and cranial disorders '1nd posloperati\·ely. High levels of vasopressin or nntidiuretic hormone (ADH) are secreted at a low thr\'.'shold or continuously despite low osmolality. The presence of hyponatremia' plus a urine osmolality higher th;m nrnximal dilution confirms the diagnosis. SIAD should be differentiated from cerebral salt wasting which i~ also associated. with central nervous system disorders. In the l:ltter, there is hypovolemic hyponatremia and high urinMy sodium (>80 mEq/L} due to increase in blood lcn~ls of natriuretic factor(s). SIAD is characterized by ex\'olcmia or mild volume expansion, inappropriate urinary concentration (urine osmolality > 100 mOsm/kg), nnd high urine sodium (>20-30 mEq/L}. In presence of elcv0.5 1 mEq/L/hour Adjust fluid on basis of clinical status and serum sodh~m 1 concentration; if child develops seizures (due to rapid ~ correction) 3% NaCl (4-6 mL/kg over 30 min) is indicated.! .• Replace ongoing losses as they occur i \ ·• Ide~~fy ~d _treat ~e _unde~lying cau~e) 1 • 0.5 mEq/L/hr should be the goal rate of correction. Renal replacement therapy is indicated for concurrent renal failure and volume overload. stasis until the glomerular filtration rate drops to less t~an 15-20 mL/min. Excretion is increased by ald osterone,h1gh sodium delivery to the collecting duct (e.g. diur~tics), urine flow (e.g. osmotic diuresis) , blood p ota_ssmn level, glucocorticoids, ADJ-I and delivery of negatively ch~rged ions to the collecting duct (e.g. bicarbonate). In renal failure, the proportion of potassium excreted through the .gut increases, chiefly by the colon in exchange for lummal sodium. Aldosterone and insulin play important roles in potassium homeostasis. Insulin stimulated by potassium ingestion increases uptake of potassium in muscle cells, through increased activity of the sodium. pum_p. High potassium levels stimulate its renal secretion vza aldosterone-mediated enhancement of distal expression of secretory potassium channels (ROMK). Insulin, betaadrenergic stimuli and alkalosis enhance potassium entry into cells. The reverse happens with glucagon, a-adrenergic stimuli and acidosis. Hypokalemia Hypokalemia is defined as a serum potassium level below 3.5 mEq/L. The primary pathogenetic mechanisms result- ing in hypokalemia include increased losses, decreased intake or transcellular shift (Table 6.7). Vomiting, a common cause of hypokalemia, produces volume depletion and metabolic alkalosis. Volume depletion leads to secondary hyperaldosteronism, which enhances sodium resorption and potassium secretion in the cortical collecting tubules. Metabolic alkalosis also increases potassium ~ecretion due to the decreased availability of hydrogen ions for secretion in response to sodium reabsorption. . Regardless of the cause, hypokalemia produces similar signs ai:d symptoms. Symptoms are nonspecific and predominantly are related to muscular or cardiac function. Severe kn hypokalemia (

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