Vital Notes for Nurses: Health Assessment
Health Assessment

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Preface

The healthcare climate has been undergoing rapid changes, with renewed emphasis on holistic assessment and evidence-based care of clients and patients. There is also the broadening of the scope of practice for nurses, professional academic awards and professional standing for nurses. Nurses are also accountable for their practice and must be able to apply theory to practise safely and effectively. Hence, the knowledge and skills underpinning holistic health assessment to practise effectively to ensure protection of the public are of vital importance. Crucial to this will be the nurse’s ability to assess patients and clients holistically in a variety of settings, to identify their needs, plan and deliver evidence-based and holistic healthcare. Programmes for the education and preparation of nurses should therefore foster an enquiring approach to care. They should also encourage progressive development and the use of appropriate analytical, critical and problem-solving skills. It is important to provide opportunities for nursing students to gain the theoretical knowledge which informs the assessment of patients and clients, enabling them to become competent nurses, able to work safely, confidently and flexibly within a multidisciplinary team setting.

Most current books on health assessment in nursing tend to focus on detailed physical assessment of the client with little or no emphasis on a holistic approach. They are also based on American rather than on generic models of assessment. Moreover, there is little focus on the fundamental knowledge informing health assessment. The intention of this book is to fill such gaps.

This book will therefore be of particular relevance for undergraduate nursing students in foundation programmes both nationally and internationally. It will also be useful to return-to-nursing students and already qualified staff would find it a helpful teaching tool.

Anna Crouch and Clency Meurier

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Anna Crouch and Clency Meurier
I would like to dedicate this book to the Lord Jesus. 

Anna Crouch

I would like to dedicate the book to Marnie, Christopher and Annabel

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Section 1: Introduction

Whether a health assessment is being performed to identify a health problem or to evaluate risk factors for health education purposes, a good understanding of biological knowledge is important (Carroll, 2004). Familiarisation with the common terminologies used for the different structures of the body, for example, enables effective communication of assessment findings to colleagues and other health professionals. Disease states and their impact can only be fully appreciated against the background of normal body structure and functions. In this chapter, the body will be looked at in a systematic way, starting from an examination of its basic organisation and the maintenance of internal stability to looking at individual organ systems.
Anatomical terms

To begin with, it is useful to provide an orientation of the body – looking at body regions, directional terms to describe one body part relative to another, and spaces and cavities that contain the different internal organs. This will facilitate precise and concise reporting of the assessment of the body. By using the exact anatomical term to describe the area of complaint of a particular symptom, attention can be focused more quickly to that specific area (Thibodeau & Patton, 2004).

Body regions

The body is conventionally divided into two major regions:

- **Axial.** This consists of the head, face, neck and trunk or torso.
- **Appendicular.** This consists of the shoulder girdles, the upper limbs, pelvic girdles and lower limbs.

Directional terms

Directional terms are used to locate body structures. They are usually grouped in opposite pairs, e.g. superior/inferior, anterior/posterior. Directional terms only make sense when they are used to describe one structure relative to another. We refer, for example, to the elbow being superior to the wrist although they are both located in the superior aspect of the body. Directional terms are shown in Table 1.1.

Body cavities

The internal organs are located within spaces in the body called cavities. There are two main cavities: dorsal and ventral. The dorsal cavity, situated near the dorsal surface of the body, contains the brain in the cranial cavity and the spinal cord in the vertebral canal. The ventral cavity, located near the anterior part of the body, can be further divided into three cavities, namely thoracic, abdominal and pelvic. The diaphragm separates the thoracic cavity from the abdominal cavity. The largest organs in the thoracic cavity are the lungs. The heart is embedded in the mediastinum, i.e. the space between the two lungs. There is no physical separation between the abdominal and pelvic cavities and they are often referred to as the abdominopelvic cavity. The cavities contain internal organs that are collectively called viscera. To enable the precise location of organs, the abdominopelvic cavity is divided into nine smaller compartments as shown in Figure 1.1.
Table 1.1 Directional terms.

<table>
<thead>
<tr>
<th>Directional term</th>
<th>Definition</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Superior</td>
<td>Towards the top. Upper part of a structure. Towards the head (cephalic or cranial)</td>
<td>The head is superior to the lower limbs and the knee is superior to the ankle</td>
</tr>
<tr>
<td>Inferior</td>
<td>Towards the bottom. The lower part of a structure. Away from the head</td>
<td>The diaphragm lies inferiorly to the lungs</td>
</tr>
<tr>
<td>Anterior or ventral</td>
<td>Towards the front</td>
<td>The sternum is anterior to the heart</td>
</tr>
<tr>
<td>Posterior or dorsal</td>
<td>Towards the back</td>
<td>The thoracic vertebrae are posterior to the heart</td>
</tr>
<tr>
<td>Medial</td>
<td>Towards the midline</td>
<td>The heart is medial to the lungs</td>
</tr>
<tr>
<td>Lateral</td>
<td>Further away from the midline. Towards the sides</td>
<td>The lungs are lateral to the heart</td>
</tr>
<tr>
<td>Proximal</td>
<td>Refers to a structure that is closer to any point of reference</td>
<td>The proximal part of the nerve running along the arm is the part closest to the spinal cord</td>
</tr>
<tr>
<td>Distal</td>
<td>Further away from a point of reference</td>
<td>In the hand, the phalanges are distal to the carpals</td>
</tr>
<tr>
<td>Superficial</td>
<td>Towards or on the surface of the skin</td>
<td>The skin is superficial to the muscles</td>
</tr>
<tr>
<td>Deep</td>
<td>Away from the surface of the body</td>
<td>The intestines are deep to the surface of the skin of the abdomen</td>
</tr>
</tbody>
</table>

Figure 1.1 Abdomino-pelvic regions
Levels of organisation of the body

The human body and its many parts are categorised into six levels of organisation, which influence body structure and functions. Ranging from the smallest to largest, these differing levels are as follows.

**Chemical level**

The body is made up of atoms and molecules. Atoms (e.g. carbon, oxygen, hydrogen) are the smallest units of matter. When two or more atoms joined together, they become molecules (e.g. water). Molecules in turn combine with other atoms and molecules to form macromolecules in the cytoplasm of the cells, which enables normal cellular functions. If this is not maintained, disease or death may result.

**Cellular level**

Cells are the basic structural and functional units of an organism. They consist of atoms and molecules. Each human organism begins life as a single cell, when the sperm fertilises the ovum. The fertilised ovum, now called a zygote, then divides into two cells, four cells, eight cells and so on. During development, these cells undergo differentiation, i.e. the transformation of unspecialised cells into specialised cells.

**Tissue level**

Tissues are aggregates of cells that work together to perform a particular function. The cells of the body are organised into four primary tissues: epithelial, connective, muscle and nervous. *Epithelial tissue* covers body surfaces and, lines cavities, hollow organs and ducts. *Connective tissue* is mainly a support tissue, connecting, anchoring and supporting the structures of the body. Connective tissue is characterised by large amount of extracellular material, called matrix, in the spaces between the connective tissue cells. *Muscle tissue* is responsible for movement. *Nervous tissue* consists of neurons and neuroglia. Neurons generate and transmit messages whereas neuroglia provide neurons with anatomical and functional support.

**Organ level**

Two or more different types of tissues join together to form an organ. For example, the heart is an organ and is composed of three different types of tissues: epithelial (endothelial), muscle and connective. Organs have specific functions. The specific function of the heart is to pump blood.
System level

A system is a group of organs that work together to perform a common function. The heart and blood vessels work together to transport blood around the body and is referred to as the cardiovascular system. The other systems of the body are integumentary, skeletal, muscular, nervous, respiratory, lymphatic and immune, gastrointestinal, urinary, endocrine and reproductive.

Organism level

All structures and systems in the body combine to make the human organism.

Hierarchy of functions

The levels of organisation show something of a hierarchy but each level in the hierarchy is as important as the other. Disturbance at one level may affect the activity of the other levels. This can go up or down the hierarchy as shown in Figure 1.2. For example, the chemicals within the cells influence their function, which in turn affects the activity at the next level and so on. Events at the level of the organism (and ultimately in the environment) can also affect activities of the lower levels. For instance, the availability or choice of diet can affect the functions of the cells.

The basic structure of cells

The human body is composed of billions of cells and the functions of these cells ultimately determine the function of the human organism.

Human organism/behaviour

↑ ↓

Activity of organ systems

↑ ↓

Activity of cells

↑ ↓

Chemicals

Figure 1.2 Hierarchy of phenomena in organisation of the human body
Cells are the basic unit of structure and function of the body. Cells become specialised for different tasks but their basic structure remains essentially the same. A cell has three parts (Figure 1.3):

- an outer membrane or plasma membrane
- cytoplasm
- nucleus (some cells, e.g. erythrocytes do not have a nucleus).

**The plasma membrane**

The plasma membrane is a phospholipid bilayer, into which a variety of proteins are immersed, that forms the boundary between the intracellular and extracellular environments of the cell. It controls the selective passage of substances into and out of the cell. The proteins within the cell membrane have a variety of functions. Some proteins form channels for substances to pass through. Others act as receptors, cell recognition molecules, adhesion molecules and enzymes.

**The cytoplasm**

The cytoplasm consists of all the contents, including the intracellular fluid (cytosol) and organelles, between the nucleus and the cell membrane. The organelles (listed in Table 1.2) are necessary for the biological processes of cellular life.

**The nucleus**

The nucleus is the most prominent intracellular structure and is found in most cells. Cells like the skeletal cells have multiple nuclei, while erythrocytes or red blood cells have none (Widmaier et al., 2004). The nucleus contains the genetic material, deoxyribonucleic acid (DNA). The DNA molecules are organised into genes, which carry the information that passes from one generation to the next and also contain the code for protein synthesis. Genes are arranged into single files of DNA called chromosomes. Chromosomes also contain a special class of proteins called histone proteins or histones. In humans, there are 46 chromosomes.

Although the DNA contains the code for specifying the amino acid sequences in proteins, it does not itself participate directly in the synthesis of proteins in the ribosomes (Widmaier et al., 2004). Information is transferred to the ribosomes for the assembly of proteins by the ribonucleic acid (RNA). The process of making a copy of the code, whereby information is transferred from the DNA to RNA, is called **transcription**. The RNA, also known as messenger RNA, then leaves the nucleus to travel to the ribosomes where the coded information in the RNA is used to assemble the protein – a process known as **translation**. An alteration in the sequence of the DNA is known as a **mutation**.
Figure 1.3  (a) A typical cell. (b) The plasma membrane (reproduced with permission from Bray et al., 1999)
resulting faulty code can lead to the synthesis of an abnormal protein, e.g. faulty haemoglobin in sickle cell disease.

### The environment of the cells

Cells have a fluid environment. There is fluid within the cells, around the cells and in the blood vessels. The fluid inside the cells is called intracellular fluid and that outside the cells extracellular or interstitial fluid. The fluid contains various salts or electrolytes as well as many dissolved substances, such as nutrients and oxygen. The composition of the intracellular fluid differs from that of extracellular fluid. Body fluids are located within two main compartments:

- intracellular fluid (28L in a 70kg person) and
- extracellular fluid (14L in a 70kg person, of which 11L is interstitial fluid and 3L plasma).

### Homeostasis

For the body to function normally, the internal environment of the cells has to stay relatively constant. Variables such as the chemical compo-
sition of the fluid that surrounds the cells, its temperature, acid level (pH) and glucose level have to remain stable for the cells to function optimally. Homeostasis is defined as a state of relative constancy of the internal environment (Fox, 2004). This is achieved by the balancing of inputs and outputs (Widmaier et al., 2004). All organ systems contribute to homeostasis but the nervous and endocrine systems in particular play a vital role.

**Feedback systems**

The stability of the internal environment is maintained by feedback systems or feedback loops (Figure 1.4), which is a concept derived from engineering. A feedback system is a cycle of events whereby the status of a controlled condition is continually monitored and adjusted as required. It has three basic components:

- **Receptor.** The receptor monitors changes in the controlled condition and sends the input to the control centre.
- **Control or integrating centre.** The control centre evaluates the input and sends an output to the effector.
- **Effector.** The effector receives the output from the control centre and produces a response to the changes in the controlled condition.

![Figure 1.4](image-url) **The feedback system**
Table 1.3 Major organ systems.

<table>
<thead>
<tr>
<th>System</th>
<th>Organs and tissues</th>
<th>Functions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Integumentary</td>
<td>Skin, appendages</td>
<td>Protection against injury and dehydration. Defence against micro-organisms. Temperature regulation</td>
</tr>
<tr>
<td>Nervous</td>
<td>Brain, spinal cord, peripheral nerves, cranial nerves, special sense organs</td>
<td>States of consciousness. Regulation and co-ordination of many body functions. Detection of changes in internal and external environment</td>
</tr>
<tr>
<td>Endocrine</td>
<td>Glands producing hormones – pituitary, thyroid, parathyroid, adrenal, pancreas, testes, ovaries</td>
<td>Regulation and co-ordination of activities such as growth, metabolism, reproduction, blood pressure, water and electrolytes balance</td>
</tr>
<tr>
<td>Respiratory</td>
<td>Nose, pharynx, larynx, trachea, bronchi, lungs</td>
<td>Exchange of carbon dioxide and oxygen. Regulation of blood pH</td>
</tr>
<tr>
<td>Cardiovascular</td>
<td>Heart, blood vessels (arteries, veins, capillaries), blood, lymphatic vessels and lymph</td>
<td>Transport of blood and other materials</td>
</tr>
<tr>
<td>Lymphatic and immune</td>
<td>Lymph vessels and nodes, spleen, thymus, white blood cells</td>
<td>Return of lymph to the blood. Defence against foreign invaders</td>
</tr>
<tr>
<td>Digestive</td>
<td>Mouth, pharynx, oesophagus, stomach, intestines and accessory organs such as salivary glands, pancreas, liver and gall bladder</td>
<td>Digestion and absorption of nutrients, water and salts</td>
</tr>
<tr>
<td>Urinary</td>
<td>Kidneys, ureters, bladder, urethra</td>
<td>Regulation and composition of body fluids through control secretions of salts, water and wastes</td>
</tr>
<tr>
<td>Reproductive</td>
<td>Male: testes, penis and associated ducts and glands</td>
<td>Production of sperm, transfer of sperm to females</td>
</tr>
<tr>
<td></td>
<td>Female: ovaries, fallopian tubes, vagina, mammary glands</td>
<td>Production of eggs, provision of a conducive environment for the developing embryo and foetus, nutrition of the infant</td>
</tr>
</tbody>
</table>
Negative and positive feedback systems
There are two types of feedback system: negative and positive. The negative feedback system reverses or opposes changes in a controlled condition. For example, if the blood glucose is rising or falling, it returns it to normal through a series of actions. A negative system is important for the maintenance of health. A positive feedback system reinforces changes in a controlled condition and is on the whole detrimental to health, e.g. if the body temperature starts to rise, the positive feedback system will amplify the rise.

Homeostasis and disease
Homeostasis promotes normal cellular activity (Tortora & Grabowski, 2004). Homeostatic functions operate with maximum efficiency and effectiveness during childhood and young adulthood but become less and less efficient in late adulthood and old age (Thibodeau & Patton, 2004). A disorder or disease may occur if the normal balance of the body’s processes is disturbed. If the homeostatic imbalance is severe, death may result. Tortora & Grabowski (2004) define a disorder as any disturbance of structure and/or function, and a disease as an illness characterised by a recognisable set of symptoms (subjective changes of body functions) and signs (observable changes).

Organ systems
Most of the cells of the body are isolated from the external environment. Consequently, they rely on the organ systems for their ‘servicing’, i.e. obtaining materials that are needed for their functions and removing the waste products of metabolism. As discussed, through the homeostatic regulatory mechanisms, the organ systems also ensure that the internal environment of the cells stays relatively stable. Widmaier et al. (2004) identify ten major organ systems. These are listed in Table 1.3.

Section 2: The integumentary system
The integumentary system includes the skin and its appendages, i.e. hair, nails and specialised sweat- and oil-producing glands. The skin covers the external surface and is the largest organ of the body, accounting for about 16% of the total body weight. Knowledge of anatomy and physiology of the skin and its major roles in thermoregulation, protection, sensation and vitamin D metabolism can assist nurses in assessment of skin conditions and general physiological disturbances (Casey, 2002). In fact, the skin acts as a window for many systemic disorders. For example, signs of cardiovascular, respiratory, renal, hepatic and
digestive disorders may be observed in the skin. Because of its exposed location, the skin is also vulnerable to damage from trauma and pressure, burns, ultraviolet light, micro-organisms, parasites, fungi, pollutants and allergens. Inspection of skin is a fundamental part of health assessment.

Structure of the skin

The skin consists of two main parts:

- epidermis
- dermis.

Subcutaneous (adipose) tissue connects the skin to underlying structures but is not part of the skin. It stores fat and also contains large blood vessels and pressure receptors.

**Epidermis**

The epidermis is the outer epithelial layer of the skin. It is composed of four or five distinct layers or strata. The deepest layer is the stratum basale, which continually undergoes mitotic activity or cell division to produce new skin cells. These are slowly pushed to the surface. The stratum basale also contains melanocytes, which produce melanin. Melanin provides protection from ultraviolet radiation. Ultraviolet radiation, as well as systemic hormones such as adrenocorticotrophic hormone (ACTH), stimulates production of melanin. Excess ACTH production by the pituitary gland, as in adrenal insufficiency or Addison’s disease, results in the skin becoming very tanned (Porth, 1998). If the stratum basale is destroyed, the skin cannot regenerate itself and scar tissue is formed. The outermost layer of the skin consists of dead keratinised cells that act as a strong protective barrier. Protection against mechanical abrasion is linked to the ability of the skin to desquamate (Tortora & Grabowski, 2004).

**Dermis**

The dermis is the inner layer of the skin and is connected to the epidermis by papillae. It is made of connective tissue containing collagen and elastic fibres, which give the skin its strength and elasticity. The dermis contains blood vessels and various sensory receptors as well as hair follicles and sweat glands. The deep veins in the dermis act as a reservoir for approximately 1.5 litres of blood (Bray et al., 1999). This blood is pushed back into the general circulation during haemorrhage or shock through the action of the sympathetic nervous system. This diversion of blood makes the skin look pale, cool and mottled in appearance (Porth, 2005).
The hypodermis or subcutaneous tissue

This is not strictly speaking part of the skin. The hypodermis contains a layer of subcutaneous fat cells (or adipose tissue), which forms the link between the skin and the rest of the body. The hypodermis provides a cushioning layer and some thermal insulation (Tortora & Grabowski, 2004).

The appendages or accessory structures of the skin

The hair

The human skin is covered with millions of hairs, most visible in the scalp, eyelids and eyebrows while the lips, palms of the hands and soles of the feet are hairless (Thibodeau & Patton, 2004). In response to hormone secretion at puberty, coarse hair develops in the pubic area and axilla.

Hair consists of a shaft and root. The root penetrates deep into the dermis and surrounding it is the hair follicle. Hair growth begins from a cluster of cells called the hair papilla located at the base of the hair follicle. The papilla is nourished by a dermal blood vessel. Sebaceous glands and arrector pili muscles are associated with the hair follicle.

The nails

The nails are plates of hard keratinised cells, consisting of a nail body, free edge and nail root. Under the nail is a layer of epithelium called the nail bed. The nail bed has a pink tinge as a result of the rich blood supply underneath and low oxygen levels in the blood cause the nail bed to turn blue or cyanosed (Thibodeau & Patton, 2004).

Skin glands

These are of two types: sudoriferous or sweat glands and sebaceous glands. The sweat glands are grouped into eccrine and apocrine glands. The eccrine glands are numerous and they produce a watery substance called perspiration or sweat, the main function of which is to assist in the reduction of body temperature. Indeed, evaporation of sweat from the skin surface is responsible for about 15% of heat loss at room temperature (Bray et al., 1999). The apocrine glands are found primarily in the skin of the armpit and around the genitals and produce a thick fluid. The odour associated with this secretion is due to contamination and decomposition of skin bacteria (Thibodeau & Patton, 2004).

The sebaceous glands secrete an oily substance known as sebum in the hair and skin. This lubricates the skin and hair. The increase in dryness and cracking of the skin in late adulthood and old age is due to a reduction of sebum secretion (Thibodeau & Patton, 2004).
Thermoregulation and the skin

By regulating sweat secretion and the flow of blood close to the surface of the body, the skin plays a key role in the regulation of body temperature (Thibodeau & Patton, 2004). This is achieved by a negative feedback system in which an ‘increase or decrease in the variable being regulated brings about responses that tend to move the variable in the direction opposite the direction of the original change’ (Widmaier et al., 2004: p9). Any changes in body temperature are detected by thermoreceptors in the skin and deeper organs. The information is fed back to the control centre (i.e. hypothalamus), which in turn will send impulses to the effector organs to adjust the body temperature. If the body temperature is high, there is vasodilation of the blood vessels in the skin, allowing warm blood to flow close to the skin surface, hence causing heat loss to the environment. Conversely, when the body temperature drops, vasoconstriction of the skin blood vessels takes blood away from the surface to effect a reduction in heat loss.

Section 3: The musculoskeletal system

The musculoskeletal system consists of the bones, skeletal muscles and joints. The overall function of the musculoskeletal system is to provide a rigid framework and support structure for the body as well as allowing movement in conjunction with the nervous system. Familiarity with the names, shapes and positions of individual bones enables one to locate other organs, e.g. the radial artery, where the pulse is usually taken, is named for its closeness to the radius (Tortora & Grabowski, 2004).

The human skeleton

The skeleton has two principal divisions: axial and appendicular. The axial skeleton includes the bones of the skull, face, ossicles, hyoid bone, ribs, sternum and vertebrae. The appendicular skeleton consists of the bones of the upper and lower limbs as well as the girdles (shoulder and pelvic), which connect the limbs to the axial skeleton. There are 206 bones in the adult (although there may be some biological variations): 80 in the axial skeleton and 126 in the appendicular skeleton (Tortora & Grabowski, 2004).

Bone

Bone is a connective tissue, consisting of a hard matrix that surrounds widely separated cells. The matrix also contains collagen fibres and