

AIR DAN ELEKTROLIT



Agus Riawan, S.Gz, M.Gz
Program Studi Sarjana Gizi
Fakultas Ilmu Kesehatan
Universitas Pahlawan Tuanku Tambusai



AIR

- Zat gizi ?
- Fungsi Air:
 1. Sebagai materi penyusun setiap sel tubuh

Tabel Kandungan Air pada Berbagai Jaringan

JARINGAN	KANDUNGAN AIR (%)
JARINGAN LEMAK	20
TULANG	25 – 30
JARINGAN KONEKTIF	60
HATI	70
OTOT	75
GINJAL	80
DARAH: PLASMA	90
SEL	65



2. Sebagai pelarut dalam proses pencernaan
 - Membantu dalam ‘mastication & softening’ makanan
 - Sebagai cairan saluran pencernaan
 - Membantu pergerakan makanan dalam saluran pencernaan
 - Darah (90% air) membantu membawa hasil/sisa pencernaan ke paru-paru, ginjal, dan kulit untuk dikeluarkan.



3. Sebagai komponen utama cairan tubuh (sal. Pencernaan, darah, urine)
 - Sebagai pelumas
 - Menjaga kelembaban sel
4. Membantu mengatur suhu tubuh



Summary of Heat-Producing and Heat-Losing Mechanism

Mechanism	Comment
Heat Production	<p>Most body Heat is produced by the oxidation of Food, and the Rate at Which it is produced is called the Metabolic Rate.</p> <p>The rate is affected by exercise, strong Sympathetic Stimulation, Hormones, and Body Temperatures.</p>



<p>Heat loss</p> <p>Radiation</p>	<p>Transfer of heat from the body to an object without physical contact. Example is losing heat to a cool object such as a floor.</p>
<p>Conduction</p>	<p>Transfer of heat from the body to any object in physical contact with the body such as clothing.</p>



<p>Convection</p>	<p>When the cool air makes contact with the body, it is warmed and carried away by convection currents.</p>
<p>Evaporation</p>	<p>The conversion of a liquid to a vapor in which the evaporating substance (e.g. , perspiration) removes heat from the body.</p>



Distribusi Air dalam Tubuh

1. Cairan Intraseluler
2. Cairan ekstraseluler

Pria (44– 55%) wanita (45 – 55%)

Total air tubuh (sbg % BB) – Young > adult

bayi 75% BB

dewasa 59% BB

Lansia 50% BB

Tabel 2 Distribusi Air Tubuh (Rata-rata Pria Dewasa, Normal)

No	Bagian	% BB	% Total Air Tubuh	Liter
1	Ekstraseluler	27	45	19
	❖ Plasma	4.5	7.5	3
	❖ Interstitial	12	20	8
	❖ Jar. Konektif + 'Cartilage'	4.5	7.5	3
	❖ 'Bone water'	4.5	7.5	3
	❖ Transeluler	1.5	2.5	1
2	Intraseluler (total)	33	55	23
3	Total Air Tubuh	60	100	42



Total Air Tubuh (45 l)

Ekstraseluler (15 l)		Intraseluler (30 l)
Darah/ Intravaskuler (3 l)	Interstitial (interseluler / ekstravasuler (12 l)	Intraseluler (30 l)

Na = K

28 = 1

Na = K

28 = 1

Na = K

1 = 10

Membran sel



Keseimbangan Air

■ Sumber Air bagi Tubuh:

1. Konsumsi pangan dalam bentuk cairan ~ 1 – 1.5 l/d (air, kopi, teh, susu, juice buah, sop, dll)
 2. Konsumsi pangan padat ~ kandungan air bahan pangan
 3. Hasil metabolisme zat gizi
- Metabolisme KH, Lemak, & Protein: menghasilkan air

1 gr KH → 0.60 gr air

1 gr lemak → 1.07 gr air

1 gr protein → 0.41 gr air



■ Pengeluaran Air dari Tubuh

1. Ginjal

- Terbesar ~ 1-2 l urin/hr
- Variasi tergantung pada: konsumsi cairan, tipe pangan yang di konsumsi, jumlah cairan yang dikeluarkan melalui kulit dan paru-paru.

2. Kulit

- Jumlah tergantung pada: aktivitas fisik, temperatur dan kelembagaan lingkungan.



3. Paru-paru

- ~ 400 ml/hr

4. Usus Halus

- ~ 100-200 ml air dalam feces



Summary of Fluid Intake and Output Per Day Under Normal Condition

Intake

Ingested Liquid	1600 ml
Ingested Foods	700 ml
Metabolic Water	200 ml
<hr/>	
Total	2500 ml



Output

Kidneys 1500 ml

Skin

evaporation 400 ml

perspiration 100 ml

Lungs 300 ml

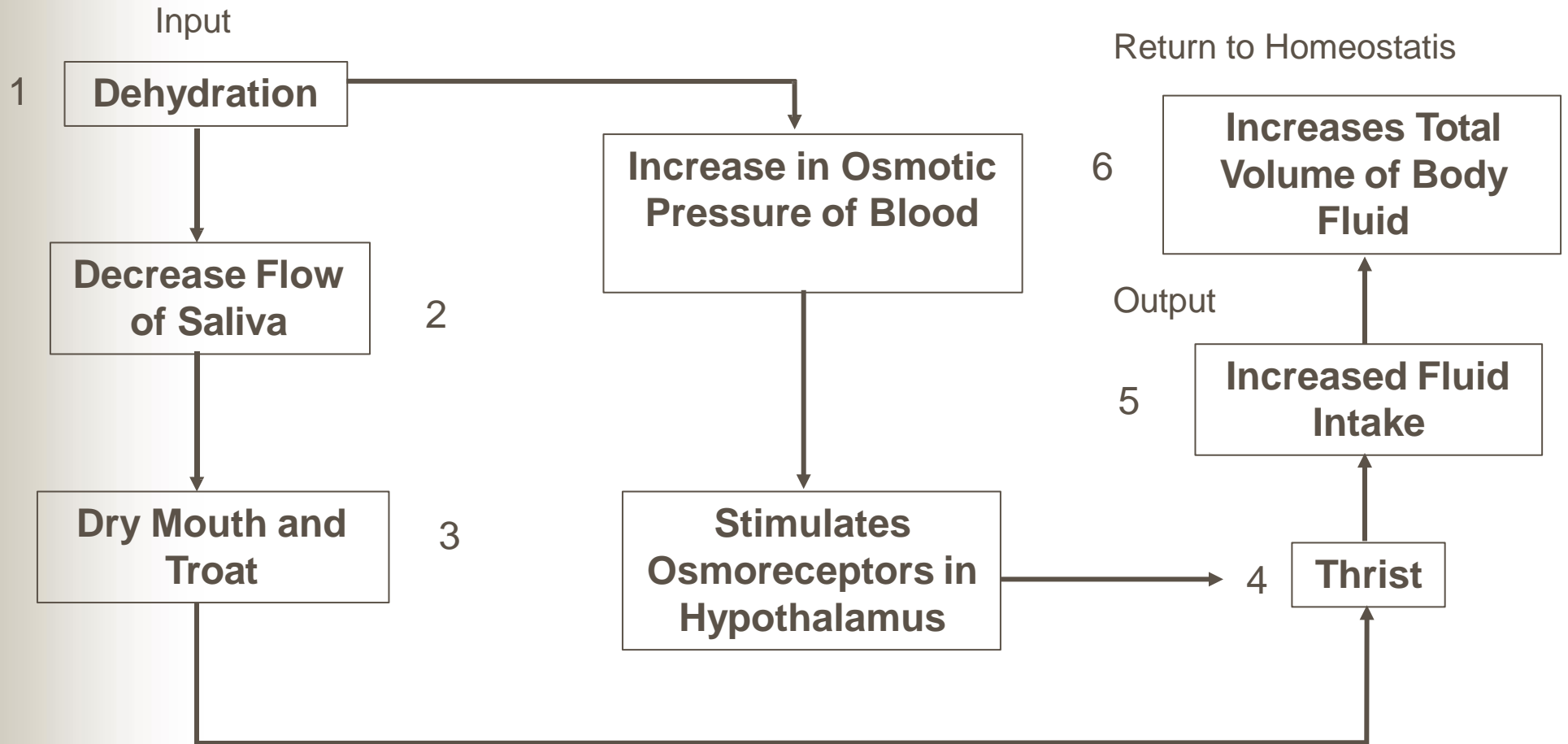
GI Tract 200 ml

total 2500 ml



Penyebaran dan Konsumsi

- Konsumsi air diatur dengan mekanisme homeostatis, rasa haus dan besarnya keluaran air.
- Hormon antidiuretik, renin dan aldosteron mempengaruhi mekanisme homeostatik
- Kemampuan konsumsi air 900-1200 ml/jam
- Rasa haus bukan indikator kekurangan cairan



Regulation of Fluid Volume by The Adjustment of Intake to Output

Ginjal

Aliran darah berkurang ginjal
produksi enzim renin

↓
Darah

Renin mengubah angiotensinogen
menjadi aktif angiotensin

↓
Angiotensin

↙
Kel. Adrenal

↘
Pembuluh Darah

Kel. Adrenal akan
mengeluarkan
aldosteron

Pembuluh darah
mengkerut, meningkatkan
tekanan darah

↓

Ginjal menahan natrium dan air, dengan demikian meningkatkan tekanan darah

Ginjal

Konsentrasi garam naik,
rangsangan terhadap kelenjar
pituitari

↓

Kelenjar Pituitari

Kelj. pituitari melepas hormon
antidiuretika (ADH)

↓

Gambar Pengaturan Keseimbangan air oleh ginjal dan otak



Kecukupan Air

1. National Research Council (NRC) (1998)

Kelompok Umur	Perkiraan Kebutuhan
Bayi & Anak	1.5 ml/Kcal Energy Expenditure
Dewasa	1-1.5 ml/Kcal Energy expenditure
Hamil	+ 300 ml/hr
Menyusui	+ 1000 ml/hr

Tabel 1. Perkiraan Kebutuhan Air



2. Food and Nutrition Research Institute (FNRI) (2002)

Kelompok Umur	Minimum Daily Requirement
Bayi (lahir-12 bln)	1.5ml/Kcal energy Expenditure
Anak (1-18 th)	
BB : 10-20kg	1000ml (+ $\bar{50}$ ml/kg) untuk setiap kg pe di atas 10 kg.
> 20kg	1500ml (+ 20ml/kg untuk setiap kg pe di atas 20kg)
Dewasa (>18 th)	1-1.5ml/Kcal Energy expenditure
Manula (>65ml)	1500ml
Hamil	+300ml
Menyusui (6 bln 1)	+750-1000ml



Kecukupan Air

Institute of Medicine (IOM) (2004)

Function	Selected Food Sources	Adverse Effects of Excessive Consumption
<p>Maintains homeostasis in the body and allows for transport of nutrients to cells and removal and excretion of waste products of metabolism.</p>	<p>All beverages, including water, as well as moisture in foods (high moisture foods include watermelon, meats, soups, etc.).</p>	<p>No UL because normally functioning kidneys can handle more than 0.7 L (24 oz) of fluid per hour; symptoms of water intoxication include hyponatremia which can result in heart failure and rhabdomyolysis (skeletal muscle tissue injury) which can lead to kidney failure.</p>

DRI : Water (IOM, 2004)

Life Stage Group	AI (L/d)	Life Stage Group	AI (g/d) (L/d)
Infant		Females	
0 – 6 mo	0.7	9 – 13 y	2.1
7 – 12 mo	0.8	14 – 18 y	2.3
		19 – 30 y	2.7
Children		31 – 50 y	2.7
1 – 3 y	1.3	50 – 70 y	2.7
4 – 8 y	1.7	> 70 y	2.7
Males		Pregnancy	
9 – 13 y	2.4	14 18 y	3.0
14 – 18 y	3.3	19 -50 y	3.0
19 – 30 y	3.7		
31 – 50 y	3.7	Lactation	
50 – 70 y	3.7	14 18 y	3.8
> 70 y	3.7	19 -50 y	3.8



DRI : Water (IOM, 2004)

UL	Special Consideration
No UL	<p>Recommended intakes for water are based on median intakes of generally healthy individuals who are adequately hydrated; individuals can be adequately hydrated at levels below as well as above the AIs provided are for total water in temperate climates. All sources can contribute to total water needs : beverages (including tea, coffee, juices, sodas, and drinking water) and moisture found in foods. Moisture in food accounts for about 20% of total water intake. Thirst and consumption of beverages at meals are adequate to maintain hydration.</p>



pH normal untuk beberapa cairan tubuh

- Darah 7.35 – 7.45
- Pankreas 8.00
- Lambung < 2.00
- Urin 6.00



Efek kekurangan dan Kelebihan

- Air:
 - Dehidarasi:
 - keringat berlebih
 - muntah-muntah
 - diare
 - Keracunan air: minum berlebihan tanpa disertai elektrolit



ELEKTROLIT

(Sodium, potasium, Klorida – Na, K, Cl)

- Definisi ?
- Dibahas bersama dengan air
 - Na – Kation utama ekstraseluler
 - Cl – anion utama ekstraseluler
 - K – kation utama intraseluler

Sodium

- 1.85 mg/kg BB
- 60-65% terdapat pada plasma darah
sisanya pada cairan di luar sel & tulang



- Fungsi:

- Menjaga 'isotonicity' cairan tubuh
- Mengontrol jumlah air tubuh
- Mengontrol keseimbangan asam basa tubuh
- Membantu transport glukosa & as. Amino melewati dinding sel

- Metabolisme:

- 95% konsumsi → diserap
- Pengeluaran → ginjal (terbesar), feces & kulit
- Jumlah Na dlm keringat
 tergantung pd suhu lingkungan
 & tingkat aktivitas fisik.



Kandungan Na pada beberapa pangan

Rendah (mg/100 gr)		Sedang (mg/100 gr)		Tinggi (mg/100 gr)	
- Apples	1	- Susu	50	- Canned Salmon	521
- Asparagus, cooked	1	- Chicken	70	- Cornflakes	914
- Grape Fruit	1	- Celery	125	- Processed Cheese	1450
- Pineapple	1	- Egg	118	- Cured ham	1310
- Egg Noodles	5	- Tomato juice canned	200	- Bacon	1957
- Sweet Potato	16	- Sardines, canned	649	- Canned salmon	2018
- Broccoli, Frozen	19				
- Raisins	12				
- Carrots	47				



Potasium (K)

- 2.6 gr /kg BB
- Lebih banyak terdapat di dalam sel
- Fungsi :
 - menjaga kenormalan tekanan osmosa cairan tubuh
 - menjaga keseimbangan asam basa tubuh
- Metabolisme :
 - 90 % diserap di usus halus
 - pengeluaran → melalui ginjal
- Disiensi → relatif jarang ditemukan
- Terjadi pada :
 - bayi dengan diare
 - puasa
 - penggunaan diuretik
 - KEP berat
 - pengobatan perlu penambahan K bersama-sama menambah intake protein
- Excess → meningkatkan pengeluaran pada urine
- Kebutuhan : 3.7 – 7.4 gr KCl



Kandungan K pada beberapa pangan

> 500 mg	300 – 500 mg	100 – 300 mg	< 100 mg
<ul style="list-style-type: none"> - Avocado - Dried apricots - Potato 	<ul style="list-style-type: none"> - Banana - Liver - Pork - Salmon - Peanut Button - Milk - Broccoli 	<ul style="list-style-type: none"> - Grapefruit - Orange - Apple - Tuna - Ham, cured - Cabbage - Carrots - Tomato - Beef - Chicken 	<ul style="list-style-type: none"> - Egg - Bread - Cereals - Sugar



Klorida (Cl)

- Banyak terdapat pada cairan ekstraseluler, plasma darah dan dalam cairan lambung
- Fungsi :
 - menjaga kenormalan tekanan osmosa cairan tubuh
 - menjaga keseimbangan asam basa tubuh
 - menjaga kenormalan asam lambung
- Metabolisme :
 - diserap di usus halus
 - pengeluaran → melalui ginjal
 - excess → meningkatkan pengeluaran melalui ginjal

Kecukupan Elektrolit

1. National Research Council (NRC) (1989)

Tabel 3. Estimated Sodium, Chloride, and Potassium Minimum Requirements of Health Person

Age	Weight (kg)	Sodium (mg)	Chloride (mg)	Potassium (mg)
Months				
0 - 5	4.5	120	180	500
6 - 11	8.9	200	300	700
Years				
1	11.0	225	350	1000
2 - 5	16.0	400	500	1400
6 - 9	25	400	600	1600
10 - 18	50	500	750	2000
> 18	70	500	750	2000

Kecukupan elektrolit

2. Food and Nutrition Research Institute (FNRI) (2002)

Tabel 4. Recommended Intake for Electrolytes for Specific Population Group

Age	Weight (kg)	Sodium (mg)	Chloride (mg)	Potassium (mg)
Months				
0 - 5	4.5	120	180	500
6 - 11	8.9	200	300	700
Years				
1	11.0	225	350	1000
2 - 5	16.0	00	500	1400
6 - 9	25	400	600	1600
10 - 18	50	500	750	2000
> 18	70	500	750	2000



3. Institute of Medicine (IOM) (2004)

DRI : Electrolytes (Sodium)

Function	Selected Food Sources	Adverse Effects of Excessive Consumption
Maintain fluid volume outside of cells and thus normal cell function	Processed foods to which sodium chloride (salt)/benzoate/phosphate have been added; salted meats; nuts cold cuts; margarine; butter; salt added to foods in cooking or at the table. Salt is ~40% sodium by weight	Hypertension; increased risk of cardiovascular disease and stroke.



DRI : Electrolytes (Sodium)

Special Consideration

The Als is set based on being able to obtain a nutritionally adequate diet for other nutrients and to meet the needs for sweat losses for individuals engaged in recommended levels or in physical activity. Individuals engaged in activity at higher levels or in humid-climates resulting in excessive sweat may need more than the AI. the UL applies to app gently healthy individuals without hypertension; it thus may be too high for individuals who already have hypertension or who are under the care of a health care professional.

DRI : Electrolytes (Sodium)

Life Stage Group	AI (g/d)	UL (g/d)	Life Stage Group	AI (g/d)	UL (g/d)
Infant			Females		
0 – 6 mo	0.12	ND	9 – 13 y	1.5	2.2
7 – 12 mo	0.37	ND	14 – 18 y	1.5	2.3
Children			19 – 30 y	1.5	2.3
1 – 3 y	1.0	1.5	31 – 50 y	1.5	2.3
4 – 8 y	1.2	1.9	50 – 70 y	1.3	2.3
Males			> 70 y	1.2	2.3
9 – 13 y	1.5	2.2	Pregnancy		
14 – 18 y	1.5	2.3	14 18 y	1.5	2.3
19 – 30 y	1.5	2.3	19 -50 y	1.5	2.3
31 – 50 y	1.5	2.3	Lactation		
50 – 70 y	1.3	2.3	14 18 y	1.5	2.3
> 70 y	1.2	2.3	19 -50 y	1.5	2.3



DRI : Electrolytes (Chloride)

Function	Selected Food Sources	Adverse Effects of Excessive Consumption
With sodium, maintains fluid volume outside cells and thus normal cell function.	See above; About 50 % by weight of salt.	In concert with sodium, results in hypertension

DRI : Electrolytes (Chloride)

Life Stage Group	AI (g/d)	UL (g/d)	Life Stage Group	AI (g/d)	UL (g/d)
Infant			Females		
0 – 6 mo	0.18	ND	9 – 13 y	2.3	3.4
7 – 12 mo	0.57	ND	14 – 18 y	2.3	3.6
Children			19 – 30 y	2.3	3.6
1 – 3 y	1.5	2.3	31 – 50 y	2.3	3.6
4 – 8 y	1.9	2.9	50 – 70 y	2.0	3.6
Males		3.4	> 70 y	1.8	3.6
9 – 13 y	2.3	3.6	Pregnancy		
14 – 18 y	2.3	3.6	14 18 y	2.3	3.6
19 – 30 y	2.3	3.6	19 -50 y	2.3	3.6
31 – 50 y	2.3	3.6	Lactation		
50 – 70 y	2.0	3.6	14 18 y	2.3	3.6
> 70 y	1.8	3.6	19 -50 y	2.3	3.6



DRI : Electrolytes (Potassium)

Function	Selected Food Sources	Adverse Effects of Excessive Consumption
<p>Maintains fluid volume inside/outside of cells and thus normal cell function; acts to blunt the rise of blood pressure in response to excess sodium intake, and decrease markers of bone turnover and recurrence of kidney stones.</p>	<p>Fruits and vegetables; dried peas; dairy products; meats, and nuts.</p>	<p>None documented from food alone; however, potassium from supplements or salt substitutes can result in hyperkalemia and possibly sudden death if excess is consumed by individual with chronic renal insufficiency (kidney disease) or diabetes.</p>



DRI : Electrolytes (Chloride)

Special Consideration

Chloride is lost usually with sodium in sweat, as well as in vomiting and diarrhea. The AI and UL are equi-molar in amount to sodium since of sodium in diet comes as sodium chloride (salt).

DRI : Electrolytes (Potassium)

Life Stage Group	AI (g/d)	UL (g/d)	Life Stage Group	AI (g/d)	UL (g/d)
Infant			Females		
0 – 6 mo	0.4	NO UL	9 – 13 y	4.5	NO UL
7 – 12 mo	0.7		14 – 18 y	4.7	
Children	3.0		19 – 30 y	4.7	
1 – 3 y	3.8		31 – 50 y	4.7	
4 – 8 y			50 – 70 y	4.7	
Males			> 70 y	4.7	
9 – 13 y	4.5		Pregnancy		
14 – 18 y	4.7		14 18 y	4.7	
19 – 30 y	4.7		19 -50 y	4.7	
31 – 50 y	4.7		Lactation		
50 – 70 y	4.7		14 18 y	5.1	
> 70 y	4.7		19 -50 y	5.1	



DRI : Electrolytes (Potassium)

Special Consideration

Individuals taking drugs for cardiovascular disease such as ACE inhibitors, ARBs (Angiotensin Receptor Blockers), or potassium sparing diuretics should be careful to not consume supplements containing potassium and may need to consume less than the AI for potassium.



Efek kekurangan dan kelebihan

- Na:

defisiensi dan kelebihan mendorong timbulnya mekanisme homeostatik, sehingga kadarnya kembali ke basal



Efek Kekurangan dan Kelebihan

- Kalium:

jarang terjadi defisiensi, kelebihan terjadi pada gagal ginjal


- Klor:

jarang terjadi kelebihan maupun kekurangan



Terima Kasih

Agus Riawan
Program Studi Sarjana Gizi
Fakultas Ilmu Kesehatan
Universitas Pahlawan Tuanku Tambusai

 riawanagus39@gmail.com

 +6281276339394