

Examinee's Number ()

令和7年8月5日実施

名古屋市立大学大学院医学研究科修士課程入学試験（1回目） 基礎科学（出題言語－英語）

Select and answer any 3 questions from the following 5 ones, and enter the selected question numbers in the box below.

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Basic Science Examination 1

Read the following text and answer the questions.

In Vital Statistics in Japan, the cause of each death is specified by selecting on the death certificate a single causative disease or injury from a sequence of ones recorded as causes directly resulting in death, in accordance with the mortality rules of the International Classification of Diseases (ICD) published by World Health Organization (WHO). Table 1 lists the first to fifth causes of death and their mortality rates per 100,000 between 1940 and 2023.

Question 1

What do you think you have to bear in mind when reading the figures in the table? Explain that from the viewpoint of whether it really reflects 'the genuine time trend'.

Question 2

Describe two points along with their respective causes/backgrounds you recognize from Table 1.

Question 3

One of the objectives of Vital Statistics in Japan is to obtain basic information to promote health policies. Discuss necessary policies at present in Japan as concrete as possible based on the information you read from Table 1.

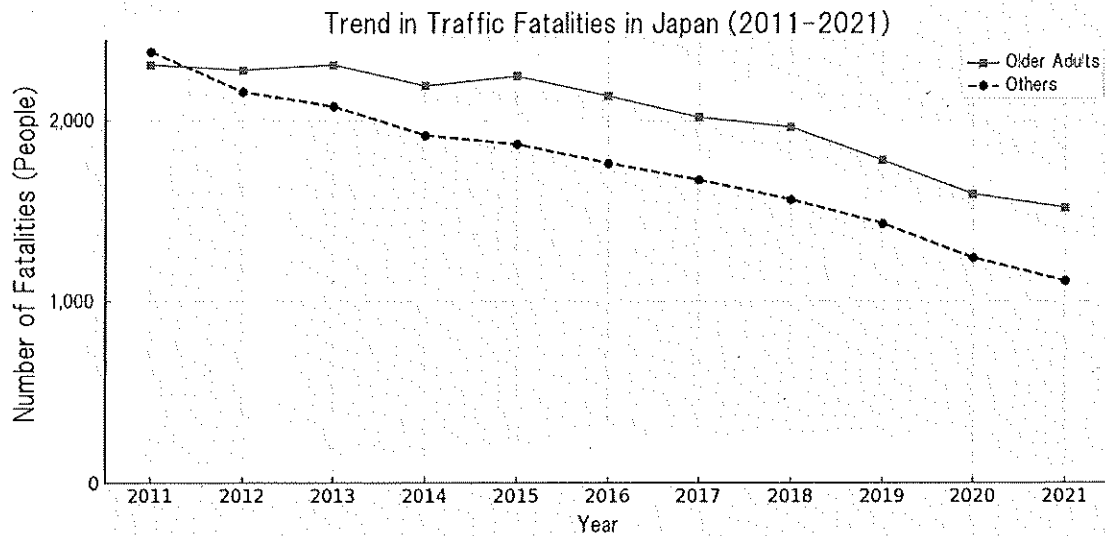
Table 1. Time trend of the order of causes of death and mortality rates (/100,000) in Japanese.

Year	1st		2nd		3rd		4th		5th	
	Cause of death	Mortality rates	Cause of death	Mortality rates	Cause of death	Mortality rates	Cause of death	Mortality rates	Cause of death	Mortality rates
1940	Tuberculosis	212.9	Pneumonia	185.8	CD	177.7	Gastroenteritis	159.2	Old age	124.5
1950	Tuberculosis	146.4	CD	127.1	Pneumonia	93.2	Gastroenteritis	82.4	MN	77.4
1955	Cerebrovascular diseases (CD)	136.1	MN	87.1	Old age	67.1	HD	60.9	Tuberculosis	52.3
1960	CD	160.7	MN	100.4	HD	73.2	Old age	58.0	Pneumonia	49.3
1965	CD	175.8	MN	108.4	HD	77.0	Old age	50.0	Accidents	40.9
1970	CD	175.8	MN	116.3	HD	86.7	Accidents	42.5	Old age	38.1
1975	CD	156.7	MN	122.6	HD	89.2	Pneumonia	33.7	Accidents	30.3
1980	CD	139.5	MN	139.1	HD	106.2	Pneumonia	33.7	Old age	27.6
1985	Malignant neoplasms (MN)	156.1	Heart diseases (HD)	117.3	CD	112.2	Pneumonia	42.7	Accidents	24.6
1990	MN	177.2	Heart diseases	134.8	CD	99.4	Pneumonia	60.7	Accidents	26.2
1995	MN	211.6	CD	117.9	HD	112.0	Pneumonia	64.1	Accidents	36.5
2000	MN	235.2	HD	116.8	CD	105.5	Pneumonia	69.2	Accidents	31.4
2005	MN	258.3	HD	137.2	CD	105.3	Pneumonia	85.0	Accidents	31.6
2010	MN	279.7	HD	149.8	CD	97.7	Pneumonia	94.1	Old age	35.9
2015	MN	295.5	HD	156.5	Pneumonia	96.5	CD	89.4	Old age	67.7
2020	MN	306.6	HD	166.6	Old age	107.3	CD	83.5	Pneumonia	63.6
2023	MN	315.6	HD	190.7	Old age	156.7	CD	86.3	Pneumonia	62.5

Cited from 'Vital Statics' by Ministry of Health, Labour and Welfare.

Basic Science Examination 2

This graph illustrates trends in traffic accident fatality numbers among older adult and non-older adult individuals in Japan from 2011 to 2021 (Source: Cabinet Office, White Paper on Traffic Safety, 2022).



Question 1

Please describe all the observable trends and findings based on the information presented in this graph.

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Question 2

Based on your observations in Question 1, list multiple possible causes or contributing factors that could explain these trends.

Question 3

For each cause mentioned in Question 2, specify the type of additional data or materials that would be necessary to verify or falsify these hypotheses.

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Basic Science Examination 3

Please answer the following questions.

Question 1.

Which of the following compounds serves as the correct biochemical precursor to dopamine? Select the most appropriate answer from the following.

- (A) Serotonin (B) L-tyrosine (C) Glutamic acid (D) GABA

Question 2.

Which of the following best describes the principal effect resulting from the inhibition of acetylcholinesterase activity? Select the most appropriate answer from the following.

- (A) Attenuation of synaptic transmission (B) Prolongation of neurotransmission (C) Excessive release of adrenaline (D) Dedifferentiation of glial cells

Question 3.

Fill in the blanks (a) and (b) with the most appropriate ions in the following description concerning neuronal membrane potential:

The ion that plays the most critical role in establishing the resting membrane potential is (a). Due to its substantial concentration gradient across the plasma membrane and the membrane's high permeability to this ion, the resting potential is predominantly maintained by its movement. Conversely, during the depolarization phase of the action potential, a rapid influx of (b) ions induces a sharp positive shift in membrane potential.

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Question 4.

Abnormal protein aggregation and intracellular accumulation are pathological features commonly observed in various neurodegenerative disorders. With reference to this phenomenon, describe the neuropathological features and clinical manifestations of Parkinson's disease.

Question 5.

Among drugs acting on the central nervous system, those that affect the GABAergic neurotransmission system are used in the treatment of anxiety, epilepsy, and sleep disorders. Explain the mechanisms underlying the development of tolerance and dependence associated with long-term use of GABAergic drugs.

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Basic Science Examination 4

Select three of the following terms and explain each in 40 words or fewer.

Central dogma, alternative splicing, ribosome, meiosis, stop codon,

3'-untranslated region, post-transcriptional regulation

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Basic Science Examination 5

A certain type of bacteria is proliferating in a closed system, and its growth rate is described by the following logistic equation:

$$\frac{dN}{dt} = rN \left(1 - \frac{N}{K} \right)$$

where $N = N(t)$ is the number of bacteria at time t , r is the growth rate, and K is the carrying capacity of the environment.

Question 1

Find the general solution of this differential equation with the initial condition $N(0) = N_0$, and plot the solution.

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Question 2

Show that the number of bacteria $N(t)$ at time t becomes independent of the growth rate r in the limit $t \rightarrow \infty$.