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INTER-GENERATION SOCIAL MOBILITY MODIFIES FRAMINGHAM RISK SCORE IN POLISH MIDDLE-AGED MEN, BUT NOT IN WOMEN

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Summary. In modern societies, there are regular social gradients in most health parameters, and also in the structure of morbidity and mortality. However, the significance of inter-generation social mobility for general health status still remains equivocal. This study was therefore performed in order to compare the effect of social mobility on coronary heart disease (CHD) risk between middle-aged Polish men and women. A total of 342 men and 458 women, aged 40 and 50 and inhabitants of Wrocław, were examined. Risk of CHD was estimated using the Framingham Risk Score (FRS), calculated for each individual. Social mobility was defined as an inter-generation change in social status expressed as educational level between the examined individual and his/her father. Using two-variable regression models, it was demonstrated that FRS in men was determined by both their father's education level (β=0·33, p<0·0001) and inter-generation change in educational status (β=0·18, p=0·008). In contrast, FRS in women was related only to their father's education level (β=0·35, p<0·0001), but not to inter-generation social mobility (β=0·35, p=0·25). In particular, an incremental change in educational level among those men whose father had finished primary school at the very most or among those whose father had finished basic trade school was accompanied by a significant decrease in FRS (F=4·12, p=0·009 and F=3·25, p=0·04, respectively). It is concluded that inter-generation social mobility modifies CHD risk (as estimated using FRS) in middle-aged Polish men, but not in women. The precise mechanisms responsible for the observed sex difference in this phenomenon need to be established in further studies.

Introduction

It is commonly accepted that socioeconomic factors significantly modify the general health status of individuals, and subsequently affect morbidity and mortality in

modern societies (Kołodziej, 1998; Łopuszańska *et al.*, 1999; Mackenbach *et al.*, 1999; Szklarska & Jankowska, 2003). Epidemiological studies focusing on these social issues are of special interest, also, in the context of public health policies (Hammer & Berman, 1995; Lin, 2004; Thurston *et al.*, 2005).

In recent years, there has been a growing interest in the phenomenon of inter-generation social mobility and its health consequences (Faresjo *et al.*, 1994; Lawlor *et al.*, 2002; Pensola & Martikainen, 2004; Singh-Manoux *et al.*, 2004). Some studies have shown that social factors in early life could influence health status in adulthood (Wadsworth, 1997; Lipowicz *et al.*, 2007). Therefore, socioeconomic status at the time of diagnosis is not necessarily the most relevant variable to be taken into account. There are some premises suggesting that an improvement in social position (described as educational level, qualified profession, income, etc.) within the structure of society by an individual in comparison with his/her parents may be advantageous for his/her health status (Faresjo *et al.*, 1994; Lawlor *et al.*, 2002; Pensola & Martikainen, 2004; Singh-Manoux *et al.*, 2004).

It has previously been demonstrated that in Poland there are regular social gradients in several parameters of health status, e.g. indices of obesity, vital capacity (Rogucka & Bielicki, 1999; Szklarska & Rogucka, 2001), and even in the structure of mortality (Brajczewski & Rogucka, 1993). But so far, the significance of social mobility has not been established in the Polish population.

In the Polish population, regular social gradients have been seen in both men and women (Wadsworth, 1997; Szklarska & Rogucka, 2001; Lipowicz *et al.*, 2007). However, there is evidence suggesting that socioeconomic factors, marital status and related elements of lifestyle may act differently in the two sexes (Łopuszańska *et al.*, 1999; Welon *et al.*, 1999; Kattainen *et al.*, 2004).

Coronary heart disease still constitutes a crucial medical, social and economic problem. This pathology is becoming the main killer of not only men, but also women, as in Europe 55% of all deaths in women are due to cardiovascular disease (Stramba-Badiale, 2006).

Therefore, this study was performed in order to compare the effects of inter-generation mobility on estimated coronary heart disease (CHD) in middle-aged Polish men and women.

Methods

Data were analysed of subjects who had been examined during the Program for Prevention of Cardiovascular Disease conducted by the Health Department in the Municipal Council in Wrocław in cooperation with the Institute of Anthropology, Polish Academy of Science. All inhabitants of Wrocław aged 40 or 50 were invited to participate in this screening programme. The response rate was approximately 25%. Unfortunately, it was not possible to assess whether and to what extant this material was selective in character. Finally, an anthropologically homogenous group of 342 men and 458 women, aged 40 and 50, and inhabitants of Wrocław, were investigated.

A standard visit of each participant in this preventive project consisted of:

(1) a cardiologist consultation, including medical history and physical examination;

(2) a resting electrocardiogram;
(3) an assessment of vital signs, including resting systolic and diastolic blood pressure;
(4) an assessment of fatness using anthropometrical indices, i.e. BMI (body mass index = weight [kg]/(height [m] ^{2}) and WHR (waist–hip ratio = waist circumference [cm]/maximal hip circumference [cm]);
(5) standard laboratory tests, including fasting plasma levels of glucose, total cholesterol, LDL-cholesterol, HDL-cholesterol and triglycerides;
(6) a questionnaire regarding the social status of the participant and his/her family, including educational level, professional career, elements of life style (also smoking) and social status of family of origin.

Based on the collected data on health status, for each individual the Framingham Risk Score (FRS) was calculated, which incorporates traditional risk factors for cardiovascular disease, i.e. age, sex, LDL-cholesterol level, HDL-cholesterol level, systolic and diastolic blood pressure, presence of diabetes mellitus, and smoking status (Wilson *et al*., 1998; D'Agostino *et al*., 2001). The FRS was derived from the Framingham Heart Study Cohort, and was design to predict a 10-year risk of major adverse coronary events, including mortality due to coronary artery disease combined with non-fatal myocardial infarction (Wilson *et al*., 1998; D'Agostino *et al*., 2001).

The social status of examined individuals and their fathers was expressed using their educational level, which is commonly accepted as a reliable and specific index of social status in Poland (Brajczewski & Rogucka, 1993; Rogucka & Bielicki, 1999; Szklarska & Rogucka, 2001). For the purpose of this analysis, all subjects were assigned to one of the following categories of educational level: (a) completed university, (b) completed secondary school, (c) completed basic trade school, (d) primary school at the very most.

Social mobility is a very wide term and could be considered in intra- and inter-generation terms. Inter-generational social mobility is defined as a different socioeconomic status in adult life than in childhood (indicated by the socioeconomic status of the parents at that time), and intra-generational social mobility as a change in socioeconomic status between two steps in adulthood (Domanski, 2004; Hallqvist *et al*., 2004). This paper focuses on inter-generation changes in social status expressed as educational level between the examined individual and his/her father. Because education as a single predictor of social class is more strongly associated with disease than are other indicators (Liberatos *et al*., 1988), level of father's education was chosen as a measure of the social position of the individual in childhood.

In the analyses, the following categories of social mobility were applied: (a) upwards: improvement in educational status – at the time of examination subject's education level was higher than his/her father's, (b) no change in educational status: there were no differences in levels of education between subject and father, (c) downwards: deterioration in educational status – at the time of examination subject's level of education was lower than his/her father's.

Inter-group differences in analysed variables were assessed using Student's t test for continuous variables or χ^2 test for categorized variables. The independent effects of social mobility (inter-generation change in educational status) on the values of FRS

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Table 1. Baseline characteristics of examined Polish men and women

Variables	Men (N=342)	Women (N=458)	p
Age, years	43 ± 4	43 ± 5	0·14
BMI, kg/m^2	27·1 ± 3·8	24·5 ± 4·7	<0·0001
WHR	0·92 ± 0·06	0·79 ± 0·06	<0·0001
SystBP, mmHg	129 ± 16	118 ± 17	<0·0001
DiastBP, mmHg	84 ± 11	77 ± 11	<0·0001
LDL-cholesterol level, mg%	125 ± 41	110 ± 30	<0·0001
HDL-cholesterol level, mg%	54 ± 14	66 ± 15	<0·0001
Diabetes mellitus, n (%)	8 (2)	3 (1)	0·04
Current smokers, n (%)	130 (38)	142 (31)	0·04
FRS, points	2·9 ± 2·9	0·0 ± 5·0	<0·0001

Data are presented as mean ± SD, or numbers and percentages, where appropriate.
BMI, body mass index; WHR, waist–hip ratio, SystBP, systolic blood pressure; DiastBP, diastolic blood pressure; LDL, low density lipoprotein; HDL, high density lipoprotein; FRS, Framingham Risk Score.

and other health parameters (dependent variables), when the father's educational level was controlled, separately in men and women, were estimated using two-variable regression models. The detailed effects of change in educational status in examined individuals in comparison with their father's on the FRS were tested – separately in men and women in particular categories of father's educational level – using a one-way analysis of variance.

Results

The baseline characteristics of the examined Polish men and women are presented in Table 1. There were no differences in mean age between male and female individuals. Men – as compared with women – were characterized by higher FRS values, higher levels of LDL-cholesterol, lower levels of HDL-cholesterol, increased systolic and diastolic blood pressure, and higher values of anthropometric indices of fatness (BMI, WHR) (all p<0·0001). The prevalence of diabetes mellitus and current smoking was greater in men than in women (Table 1).

The educational structure of the studied population and of their fathers, along with inter-generation changes in educational status, are shown in Table 2. The father's educational level was comparable between male and female subjects. More women than men improved their educational level (60% vs 52%), and the deterioration of educational status was more frequent in men than women (14% vs 9%). As a result, an average education level of examined women was better than that of men (Table 2).

The results of the two-variable regression models, demonstrating independent effects of social mobility (inter-generation change in educational status) and the father's educational level on the values of FRS and other health parameters,

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Table 2. Educational structure of examined Polish men and women, and of their fathers, along with the inter-generation changes in educational level

Variables	Men (N=342) n (%)	Women (N=458) n (%)	p
Education level of examined subjects' fathers			
University	56 (16)	63 (14)	0·70
Secondary school	91 (27)	121 (26)	
Basic trade school	115 (34)	155 (34)	
Primary school	80 (23)	119 (26)	
Education level of examined subjects			
University	103 (30)	133 (29)	0·0006
Secondary school	133 (39)	229 (50)	
Basic trade school	95 (28)	76 (17)	
Primary school	11 (3)	20 (4)	
Inter-generation change in education level (social mobility)			
Upwards	177 (52)	277 (60)	0·02
No change	117 (34)	141 (31)	
Downwards	48 (14)	40 (9)	

Data are presented as numbers and percentages.

separately in men and women, are shown in Table 3. In males, there was a significant positive effect of upward social mobility on FRS, systolic blood pressure and HDL, whereas in females there was only an effect on diastolic blood pressure. Subjects who moved up were healthier in relation to those parameters.

In males both father's education and social mobility modified FRS. In contrast, FRS (and most remaining variables) in women was related only to their father's education, and not to inter-generation social mobility.

Subsequently, the detailed effects of inter-generation change in educational status were analysed in subgroups of men and women, varying by their father's education level. A decline in educational status in those men whose fathers had graduated from university did not modify the estimated CHD risk (F=1·60, p=0·22, Fig. 1a). A worsening in educational status among those men whose fathers had finished secondary school resulted only in a borderline increase in FRS (F=2·96, p=0·059, Fig. 1b). The downwards social mobility affected FRS neither in women whose fathers had graduated from university (F=0·98, p=0·38, Fig. 1a) nor in those whose fathers had finished secondary school (F=0·17, P=0·85, Fig. 1b).

An improvement in educational level among those men whose fathers had finished basic trade school was followed by a significant decrease in FRS (F=3·25, p=0·04, Fig. 1c). The analogous pattern was observed in women (F=4·71, p=0·01, Fig. 1c). Similarly, an incremental change in educational level among those men whose fathers had finished primary school at the very most was accompanied by a gradual decline in CHD risk as estimated using the FRS (F=4·12, p=0·009, Fig. 1d). However, this effect was not observed in women (F=0·69, p=0·56, Fig. 1d).

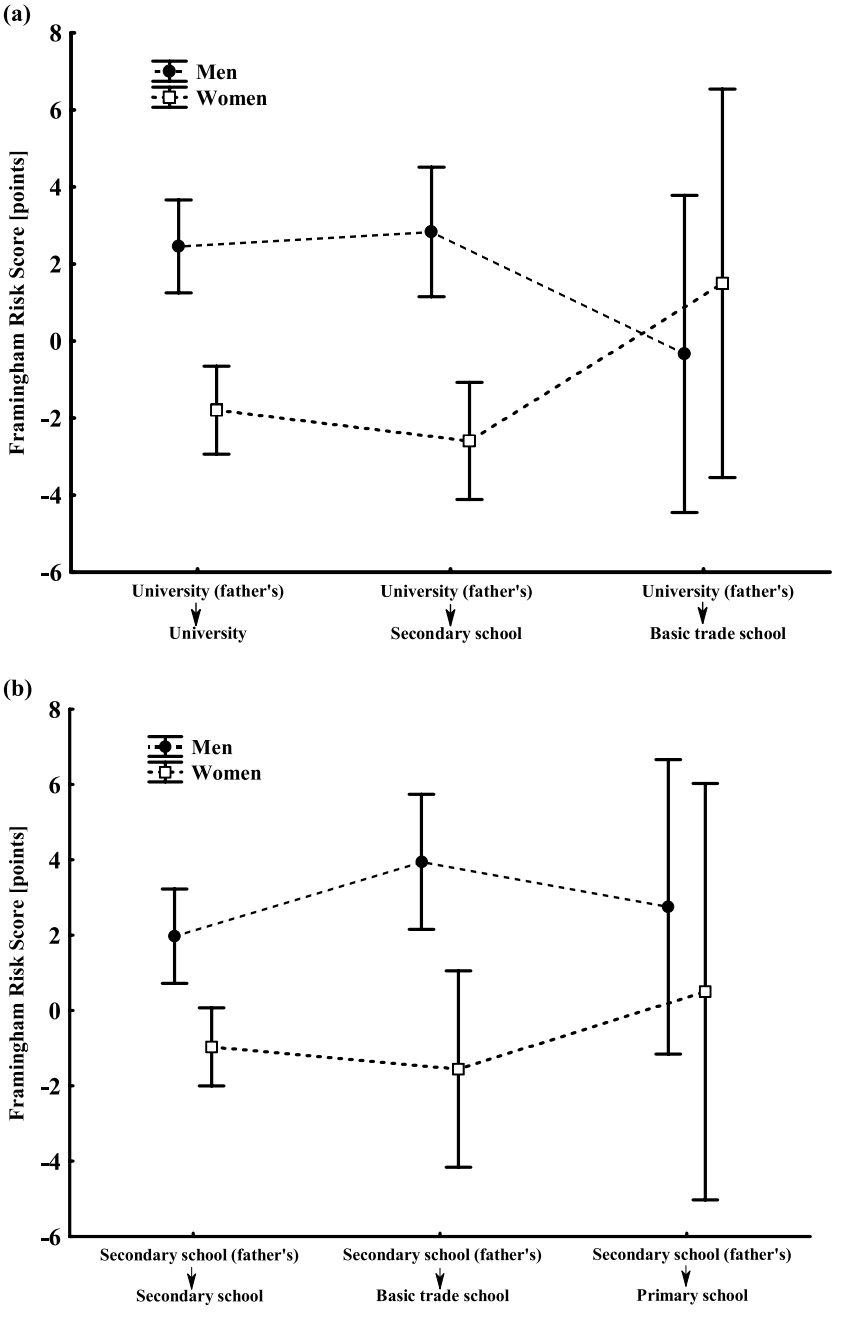
Table 3. Independent effects of the father's educational level and social mobility (inter-generation change in educational status) on FRS values and other variables, separately in men and women (two-variable regression models)

Social determinants	FRS (points)	SystBP (mmHg)	DiastBP (mmHg)	LDL-cholesterol level (mg%)	HDL-cholesterol level (mg%)	BMI (kg/m^2)	WHR
Men							
Social mobility	0·18 (p=0·008)	0·14 (p=0·05)	0·12 (p=0·08)	−0·03 (p=0·71)	0·18 (p=0·01)	0·12 (p=0·08)	0·10 (p=0·15)
Father's education	0·33 (p<0·0001)	0·20 (p=0·004)	0·13 (p=0·07)	0·05 (p=0·49)	0·08 (p=0·24)	0·10 (p=0·16)	0·07 (p=0·32)
Women							
Social mobility	0·06 (p=0·25)	0·07 (p=0·21)	0·12 (p=0·04)	−0·09 (p=0·14)	0·03 (p=0·57)	0·07 (p=0·22)	0·17 (p=0·004)
Father's education	0·35 (p<0·0001)	0·20 (p=0·0008)	0·18 (p=0·003)	0·07 (p=0·20)	−0·05 (p=0·42)	0·20 (p=0·0006)	0·25 (p<0·0001)

Data are presented as β coefficients (with p values).

Father's education: university/secondary school/basic trade school/primary school.

Social mobility (inter-generation change in educational level): upwards/no change/downwards. FRS, Framingham Risk Score; SysBP, systolic blood pressure; DiasBP, diastolic blood pressure; LDL, low density lipoprotein; HDL, high density lipoprotein; BMI, body mass index; WHR, waist–hip ratio.



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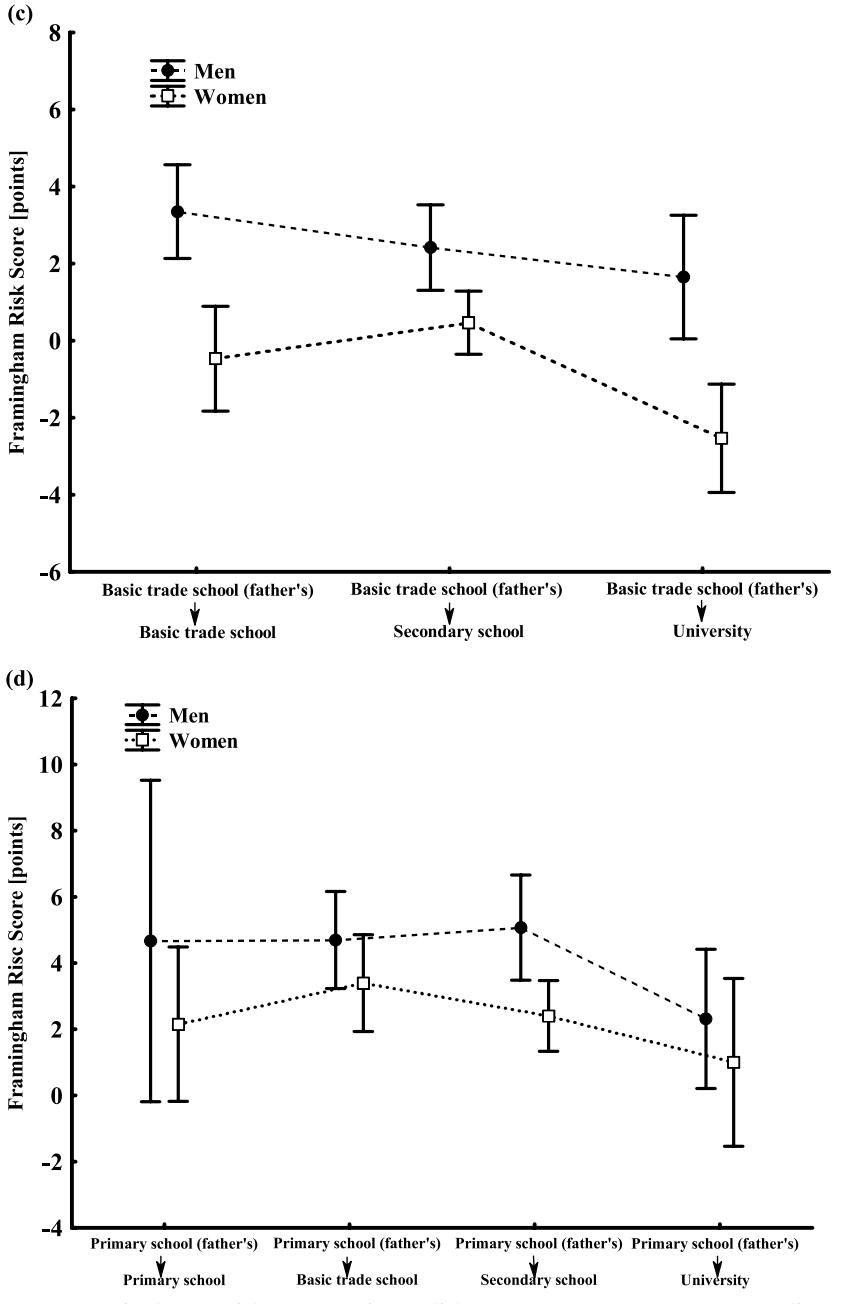

Fig. 1. Framingham Risk Scores in Polish men versus women, according to inter-generation change in educational level (means ± 95% CI).

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Discussion

In this study, it has been demonstrated that the phenomenon of inter-generation social mobility constitutes an independent determinant of CHD risk in middle-aged Polish men, irrespectively of their baseline socioeconomic background (i.e. their father's education). In contrast, no relationship was found between social mobility and FRS in middle-aged women in Poland.

In the recent literature, there is some evidence suggesting the significance of inter-generation social mobility for general health status (Faresjo *et al*., 1994; Lawlor *et al*., 2002), including all-cause and cardiovascular mortality (Pensola & Martikainen, 2003; Rosvall *et al*., 2006). In the Swedish study, 50-year-old men – whose social position deteriorated as compared with their father's status – demonstrated the worse subjective health status, reported more complaints and symptoms, and were at a slightly higher risk with regard to an occurrence of myocardial infarction (Faresjo *et al*., 1994). Singh-Manoux *et al.* (2004) demonstrated that a persistent low socio-economic status during the lifespan had a negative impact on an incidence of CHD as compared with an improvement in social status, both in male and female individuals.

Moreover, mortality for any reason, including cardiovascular deaths, was 150% higher in Finnish men who demonstrated downward social mobility as compared with their peers whose social position moved up (Pensola & Martikainen, 2003). Analogously, in the study of Rosvall *et al.* (2006), inter-generation downward social mobility was associated with high all-cause and high cardiovascular mortality, both in men and women.

It was also found that social mobility influences several traditional risk factors for cardiovascular disease, which in fact are internal elements of FRS (systolic and diastolic blood pressure, HDL-cholesterol). One of the most controversial hypotheses concerning health inequalities is health selection, and argues that health status has a casual effect on individuals' chances of upward social mobility (Cardano *et al*., 2004). Accumulation of risk throughout the life course has been proposed as an alternative hypothesis. It suggests that exposures or insults gradually accumulate to increase the risk of chronic disease and mortality and that cumulative differential lifetime exposure is the main explanation for the observed socioeconomic differences in risk of disease (Mann *et al*., 1992; Wunsch *et al*., 1996; Hallqvist *et al*., 2004). On the other hand, using longitudinal follow-up data, Power *et al.* (1991) found that health-related mobility did occur but did not explain the health inequalities and pointed out that it was rather lifetime social circumstances that were responsible.

This analysis has also revealed that inter-generation social mobility was insignificant in the context of CHD risk in middle-aged Polish women. In the literature, the opinions on links between social mobility and health indices in women are ambiguous (Lawlor *et al*., 2002; Rosvall *et al*., 2006). Some authors relate downward social mobility to increased total and cardiovascular mortality (Rosvall *et al*., 2006), whereas, for example, in the British study, an improvement in social position did not affect the prevalence of metabolic syndrome and its elements (insulin resistance, dyslipidaemia, obesity, etc.) in middle-aged women (Lawlor *et al*., 2002). The results of this study, analogously to our analysis, indicate that inter-generation social

mobility does not constitute a major determinant of health-related variables in middle-aged women (Lawlor *et al*., 2002). The rationale for these results is unclear. It could be assumed that among women, their own social advancement plays a lower role in the health inequalities than social position achieved by marriage (Lipowicz, 2003). Among women, subjective social status was more consistently and strongly related to psychological functioning and health-related factors (i.e. self-rated health, body fat distribution, and cortisol habituation to repeated stress) compared with objective indicators (Adler *et al*., 2000).

In conclusion, inter-generation social mobility modifies coronary heart disease risk as estimated using the Framingham Risk Score in middle-aged Polish men, but not in women. Beneficial effects are particularly seen in those men who improved their social position as compared with their fathers.

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