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ORIGINAL ARTICLE

Relationship between socioeconomic status and accessibility for endoscopic resection among gastric cancer patients: using National Health Insurance Cohort in Korea: poverty and endoscopic resection

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Abstract

Background Gastric cancer is one of the most common types of cancer among patients in Korea. We measured the inequity in accessibility to endoscopic mucosal/submucosal resection (EMR) for early and curable gastric cancer treatment among different income classes in patients diagnosed from late 2011 to 2013.

Methods Data were obtained from the National Health Insurance Cooperation Claim Data from patients diagnosed from late 2011 until the end of 2013, to provide a total of 1,671 patients with newly diagnosed carcinoma in situ of gastric and gastric cancer among 1,025,340 enrollees. Multiple logistic regression analysis was conducted to investigate the associations between independent variables and the rate of treatment with EMR.

Results Among 1671 gastric cancer patients, 317 (19.0 %) subjects were treated with EMR. The 'lowest' income group was associated with a statistically significant lower rate of EMR treatment [odds ratio (OR) = 0.55, 95 % confidence index (CI) 0.34–0.89] compared to the 'highest' income group. The ORs for the 'low-middle' and 'middle-high' income groups were both higher than for the reference group, although these were not significantly different. According to the subgroup analysis by gender, rate of EMR treatment of 'lowest' income group (OR = 0.37, 95 % CI 0.18–0.74) was significantly lower only among men.

Conclusion In conclusion, we suggest that although universal health insurance in Korea has covered EMR treatment since August 2011, patients from the lowest income group are less likely to receive this treatment. Thus, we need to detect more eligible early-stage gastric cancer and treatment for individuals of low socioeconomic status.

Keywords Endoscopic resection · Socioeconomic status · Gastric cancer · Inequality · Endoscopy · Screening · Korea

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Introduction

Gastric cancer is one of the most frequently occurring cancers throughout the world and is especially prevalent in Korea. Among men, gastric cancer has been the most common type of cancer since 1999. In addition, one-fourth of all female cancer patients have suffered from gastric cancer (National Cancer Center). According to Health Insurance Review and Assessment Service (HIRA) in 2014, gastric cancer is one of the leading causes of hospital visits among all types of cancer, second only to thyroid cancer. In addition, the number of patients with gastric cancer in Korea has increased consistently. According to HIRA, 147,000 patients were treated for gastric cancer in 2013, which is 16 % higher than in 2009.

Although there is a high incidence of gastric cancer, it is easily curable. If it is diagnosed and treated in the early stage, the patient can make a full recovery [1, 2]. Endoscopic mucosal/submucosal resection (EMR) is an effective treatment method for gastric cancer patients. Using EMR, a drug is injected beneath the mucous membrane of a lesion through the endoscopic device, and the mucosa surrounding the lesion is grasped, lifted, strangulated, and resected by electrocautery [3]. Compared with laparotomy, EMR results in an easier recovery, less pain, and a smaller operation wound [4].

Previously, EMR had not been covered by medical insurance, and, consequently, relatively poor patients could not easily access EMR. In August 2011, however, medical insurance began covering treatment of gastric cancer with EMR. Despite this change in policy, there has been no difference in the number of the patients with gastric cancer being treated with EMR [5]. This lack of difference raises doubt that patients actually have access to treatment with EMR under the revised medical insurance policy. Therefore, we studied the association between accessibility to EMR treatment and the income level of patients.

Methods

Data

This study used Korean National Health Insurance Service National Sample Cohort (NHIS-NSC) cohort data, which include information about approximately 1 million patients and have been used for many other publications [6, 7]. The data are randomly sampled and stratified according to age, gender, region, health insurance type, income decile, and individual total medical costs from 2002 to 2013. All Korean citizens are obligated to join the National Health Security System, which comprises the NHI and Medical Aid and is overseen by the Ministry of Health and Welfare. The data include a unique anonymous number for each patient and summarize age, gender, type of insurance, a list of diagnoses according to the International Classification of Diseases (ICD-10), medical costs claimed, prescribed drugs, and medical history. In addition, the unique anonymous numbers are linked to information on mortality obtained from the Korean National Statistical Office.

Participants

We conducted a cohort study of newly diagnosed gastric cancer patients, with carcinoma in situ of the gastric (ICD-10 code: *D00.2*) and malignant neoplasm of the gastric (ICD-10 code: *C16*), using a 2.5 % stratified random sample (n = 1,025,340) of all citizens on December 31, 2002 (Fig. 1). From this pool, we selected 8,833 patients with a primary diagnosis of gastric cancer from 2002 to 2013. Among them, 7,162 patients with preexisting gastric cancer in July 2011 were removed because coverage of EMR by the national health insurance began in August 2011. After these patients were eliminated, 1,671 patients who were free of the disease before July 2011 were selected.

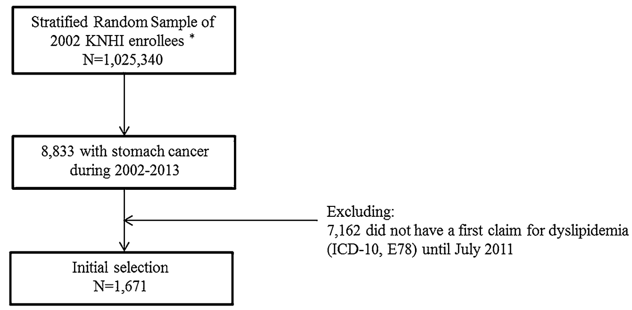

Fig. 1 Flowchart for sample selection. Source: KNHI Korean National Health Insurance

Covariates

Demographic characteristics including age, gender, and residential area were analyzed, as well as medical history of hypertension, diabetes, and disabled status. The specific ICD codes were as follows: hypertension, *I.10–I.15*; diabetes, *E.10–E.14*.

In terms of residential area, we defined residential area by whether the administrative district is located in a metropolitan area. In Korea, there are seven metropolitan cities of more than 1 million in population: Seoul, Busan, Incheon, Daejeon, Daegu, Gwangju, and Ulsan. The patients living in these cities are categorized as 'metropolitan' and all others as 'non-metropolitan.'

We also considered the level of hospitals where patients were treated with endoscopic resection and divided all hospitals using a hierarchy with three components including tertiary hospitals, secondary hospitals, and primary clinics. Primary clinics are mainly responsible for outpatient visits. Secondary hospitals are usually defined as the second level in the healthcare system: these hire the specialists and manage some complicated cases and acute inpatient cases that are not suitable for primary clinics. Tertiary hospitals are the tertiary referral centers with subspecialists and a large number of beds.

Individual-level income measures

Regarding individual income levels, the NHI premium was used as a proxy measure of precise income because it is proportional to monthly income, including earnings and capital gains. The income deciles of enrolled subjects were categorized into the following four groups: 'lowest,' first to second decile; 'middle-low,' third to fifth decile; 'middle-high,' sixth to eighth decile; and 'highest,' ninth to tenth decile.

Neighborhood-level socioeconomic status

A summary measure was used to characterize neighborhood-level deprivation. We used a modified Townsend and Carstairs index [8] for the Korean situation based on census and other administrative data [9]. In previous studies, four variables from census data were used to calculate the Carstairs index: (1) residents in households headed by unskilled individuals, (2) unemployed males, (3) residents overcrowded, and (4) residents without a car [10–12]. However, because we could not obtain car ownership information from census data, we replaced 'residents without a car' with 'residences not owner occupied.' The values were derived for each area using 2 % microdata from the 2005 Population and Housing Census from the Korea National Statistical Office. A positive, higher score on the index denotes greater deprivation. This modified index displays a significant association with health and has been shown to be robust for consistency over time and over outcome variables in many previous studies in Korea [9, 13–15]. Thus, the use of this verified area deprivation index provides more reliable results and could help in developing an area-deprived index suitable for health-related studies in South Korea.

The neighborhood deprivation index was calculated at the level of Si (city), Gun (county), and Gu (borough) by merging these four basic indicators, similar to the method used to calculate the Carstairs index. Si, Gun, and Gu are geographic units covering all small areas in Korea. We calculated a z score at the level of Si, Gun, and Gu using the mean and standard deviation of the four indicators. The z score was calculated by subtracting the mean from the observed value for each indicator, dividing the standard deviation by this value, and then summing the four standardized z scores. The indexes were categorized into three groups: 'low' (the least deprived), 'middle,' and 'high' (the most deprived) neighborhoods.

Statistical analysis

Before statistical analyses, we assessed the distribution of the demographic characteristics among gastric cancer patients at baseline. Continuous variables were expressed as means and standard deviations and were compared using t tests or the Kruskal–Wallis test where appropriate. Baseline categorical variables were expressed as numbers and percentages and were compared using the χ^2 test.

We also estimated the adjusted odds ratios (ORs) and 95 % confidence intervals (CIs) of the chance for endoscopic resection by applying a multiple logistic regression model. Model fitting was performed using the PROC LOGISTIC process in SAS version 9.3 (SAS Institute, Cary, NC, USA).

Results

Demographic characteristics of gastric cancer patients

Table 1 presents the demographic characteristics of the gastric cancer patients in this study. A total number of 1671 gastric cancer patients who were newly diagnosed from late 2011 to end 2013 were enrolled in the study. The annual incidence rate for gastric cancer observed in this study was approximately the same as the published national data (Supplementary Figure 1).

Table 2 summarizes the patients according to whether they received EMR treatment. Among them, 317 gastric cancer patients (19.0 %) received EMR treatment but 1354 gastric cancer patients (81.0 %) did not. A significant difference in EMR treatment rate was observed between patients of the lowest income group compared to the other income level groups ($p = 0.024$). Additionally, it was observed that the variables of age ($p = 0.001$) and hospital ($p < 0.001$) led to significant differences in the EMR treatment rate.

Multivariate analysis

Table 3 displays the results of logistic regression analysis, including OR and 95 % confidence intervals (CI), for the relationship between the covariates and EMR treatment rate. For gender, the difference between the EMR rates for men and women (OR = 0.98, 95 % CI 0.75–1.29) was not significant. Also, there was no significant difference in EMR rates in the presence of hypertension (OR = 1.14, 95 % CI 0.86–1.50), diabetes (OR = 0.87, 95 % CI 0.65–1.15), or disabled status (OR = 0.77, 95 % CI 0.52–1.14). There was a significant difference between the lowest income group (OR = 0.55, 95 % CI 0.34–0.89) and the highest income group, but not in the low-middle income group (OR = 1.04, 95 % CI 0.74–1.47) or middle-high income group (OR = 1.07, 95 % CI 0.79–1.45). We also analyzed variables including residential area, hospital, and Carstairs index. For residential area, there was no significant

Table 1 Demographic characteristics of gastric cancer patients from late 2011 to 2013

Variables	*n*	%
Gender		
Men	1126	67.4
Women	545	32.6
Income		
Lowest	205	12.3
Low-middle	301	18.0
Middle-high	440	26.3
Highest	725	43.4
Age (years)		
<50	233	14.2
50–59	400	23.8
60–69	424	25.4
≥70	614	36.6
Residential area		
Non-metropolitan	589	35.3
Metropolitan	1082	64.7
Hypertension		
No	765	45.8
Yes	906	54.2
Diabetes		
No	1105	66.1
Yes	566	33.9
Disabled status		
No	1455	87.1
Yes	216	12.9
Year		
2011	390	23.3
2012	674	40.4
2013	607	36.3
Hospital level		
Tertiary hospitals	1354	81.0
Secondary hospitals	118	7.1
Primary clinics	199	11.9
Carstairs index		
Low (the least deprived)	557	33.3
Middle	560	33.5
High (the most deprived)	554	33.2
Total	1671	100.0

difference in EMR treatment rate between patients living in non-metropolitan areas (OR = 1.12, 95 % CI 0.85–1.45) and those in metropolitan areas. There was a significant difference in EMR treatment rate among patients treated in a tertiary hospital or a secondary hospital (OR = 0.36, 95 % CI 0.19–0.70) and those treated in a clinic (OR = 0.35, 95 % CI 0.21–0.58). By Carstairs index, there was no significant difference in the EMR treatment rate between the disadvantaged group (OR = 1.16, 95 % CI 0.90–1.50) and the advantaged group.

Subgroup analysis by gender and age

Table 4 demonstrates the results of logistic regression analysis, which assessed the association between income level and the rate of EMR treatment by gender and age. Among men, the lowest income group had a lower odds ratio (OR = 0.37, CI 0.18–0.74) than the highest income group. Among women, there was no significant difference among the four income groups, as observed in the comparison of the highest income group with the lowest income group (OR = 95, 95 % CI 0.47–1.94), low-middle income group (OR = 1.10, 95 % CI 0.57–2.13), and middle-high income group (OR = 1.65, 95 % CI 0.95–2.87).

Last, we categorized four subgroups by age as follows: <50 years, 50–59 years, 60–69 years, and ≥70 years (Supplementary Table 1). There were no data corresponding to the lowest income group for the <50 years and 50–59 years subgroups. In the <50 years subgroup, there was no significant difference between the low-middle income group (OR = 1.90, 95 % CI 0.69–5.18), the middle-high income group (OR = 1.04, 95 % CI 0.39–2.80), and the highest income group. In the 50–59 years subgroup, there was no significant difference between the low-middle group (OR = 0.83, 95 % CI 0.42–1.64), the middle-high income group (OR = 0.79, 95 % CI 0.42–1.46), and the highest income group. In the 60–69 years subgroup, there was no significant difference between the lowest income group (OR = 0.45, 95 % CI 0.19–1.07), the low-middle income group (OR = 0.74, 95 % CI 0.40–1.37), the middle-high income group (OR = 0.72, 95 % CI 0.42–1.25), and the highest income group. In the ≥70 years subgroup, there was no significant difference between the lowest income group (OR = 1.16, 95 % CI 0.60–2.24), the low-middle income group (OR = 1.29, 95 % CI 0.68–2.45), and the highest income group, but there was a significant difference between the middle-high income group (OR = 2.04, 95 % CI 1.21–3.43) and the highest income group.

Discussion

In this study, we analyzed all gastric cancer patients diagnosed between late 2011 and 2013. We used logistic regression analysis to determine if there was a relationship between income level and the rate of EMR. We divided the patients into four groups by income into the lowest, low-middle, middle-high, and highest income groups. Compared with the highest income group, the low-middle

Table 2 Demographic characteristics of gastric cancer patients from late 2011 to 2013 by treatment group (endoscopic mucosal/submucosal resection versus no endoscopic mucosal/submucosal resection)

	No EMR treatment		EMR treatment		Total	*p* value
	n	%	*n*	%	*n*	
Gender						
Men	908	80.6	218	19.4	1126	0.559
Women	446	81.8	99	18.2	545	
Income						
Lowest	182	88.8	23	11.2	205	0.024
Low-middle	241	80.1	60	19.9	301	
Middle-high	348	79.1	92	20.9	440	
Highest	583	80.4	142	19.6	725	
Age (years)						
<50	202	86.7	31	13.3	233	0.001
50–59	330	82.5	70	17.5	400	
60–69	317	74.8	107	25.2	424	
≥70	505	82.2	109	17.8	614	
Residential area						
Non-metropolitan	475	80.6	114	19.4	589	0.768
Metropolitan	579	74.0	203	26.0	782	
Hypertension						
No	631	82.5	134	17.5	765	0.164
Yes	723	79.8	183	20.2	906	
Diabetes						
No	892	80.7	213	19.3	1105	0.656
Yes	462	81.6	104	18.4	566	
Disabled status						
No	1173	80.6	282	19.4	1455	0.266
Yes	181	83.8	35	16.2	216	
Year						
2011	327	83.8	63	16.2	390	0.132
2012	532	78.9	142	21.1	674	
2013	495	81.5	112	18.5	607	
Hospital level						
Tertiary hospitals	1064	78.6	290	21.4	1354	<0.001
Secondary hospitals	108	91.5	10	8.5	118	
Primary clinics	182	91.5	17	8.5	199	
Carstairs index						
Low (the least deprived)	453	81.3	104	18.7	557	0.976
Middle	453	80.9	107	19.1	560	
High (the most deprived)	448	80.9	106	19.1	554	
Total	1354	81.0	317	19.0	1671	

Carstairs index is an indicator for neighborhood deprivation; a positive, higher score on the index denotes greater deprivation

EMR endoscopic mucosal/submucosal resection

income group and middle-high income group revealed no significant difference in EMR treatment rate; however, the lowest income group showed a significance difference in EMR treatment rate.

Based on the results of this study, it was observed that gastric cancer patients with income below a certain level have a lower likelihood to be treated using EMR. As EMR treatment can be used only in the early stage of gastric cancer, we inferred that low-income status leads to lower probability for early diagnosis of cancer. This delayed detection consequently leads to a higher mortality rate [16–21].

Table 3 Adjusted odds ratios for each demographic group for treatment with endoscopic mucosal/submucosal resection

	OR	95 % CI	*p* value
Gender			
Men	1.00		
Women	0.98	(0.75–1.29)	0.892
Income			
Lowest	0.56	(0.34–0.90)	0.016
Low-middle	1.04	(0.74–1.48)	0.809
Middle-high	1.07	(0.79–1.45)	0.651
Highest	1.00		
Age (years)			
<50	1.00		
50–59	1.35	(0.84–2.15)	0.215
60–69	2.17	(1.37–3.45)	0.001
≥70	1.41	(0.88–2.25)	0.151
Residential area			
Non-metropolitan	1.10	(0.84–1.44)	0.482
Metropolitan	1.00		
Hypertension			
No	1.00		
Yes	1.14	(0.86–1.51)	0.365
Diabetes			
No	1.00		
Yes	0.87	(0.65–1.15)	0.315
Disabled status			
No	1.00		
Yes	0.77	(0.52–1.14)	0.195
Year			
2011	1.00		
2012	1.43	(1.02–1.99)	0.037
2013	1.20	(0.85–1.69)	0.313
Hospital level			
Tertiary hospitals	1.00		
Secondary hospitals	0.36	(0.18–0.70)	0.003
Primary clinics	0.35	(0.21–0.59)	<0.001
Carstairs index			
Low (the least deprived)	1.00		
Middle	1.03	(0.76–1.40)	0.85
High (the most deprived)	1.06	(0.78–1.45)	0.713

OR odds ratio for endoscopic mucosal/submucosal resection (EMR), *CI* confidence interval for EMR

When we inquire why patients of the lowest income level so infrequently receive EMR treatment, they have lower likelihood of being screened to diagnose cancer. In fact, according to the previous study in Korea for participation rate in cancer screening from the Korea National health and Nutrition Examination Survey (KHANES) [22], a cross-sectional nationwide study conducted by the Korean Ministry of Health and Welfare from 2007 to 2011, the disparities in screening participation were observed at all income levels.

We infer that the reasons for the low participation rate in the cancer screening program are as follows. The first issue may be the cost of gastric cancer screening [23, 24]; however, in Korea, everyone has national health insurance, so lack of time for screening because of work or other obligations may be a larger barrier [25, 26]. In addition, because of a lack of time, those diagnosed prefer the upper gastrointestinal (UGI) series to diagnostic endoscopy [27]. According to Choi et al., household income has an association with the rate of UGI and endoscopy. They found that people of highest income are less likely to have UGI treatment (OR = 0.93, 95 % CI 0.64–1.35) and more likely to have endoscopy (OR = 1.42, 95 % CI 1.07–1.89) compared to the lowest income group. Several previous studies also describe an association between income and stage of gastric cancer when diagnosed [28–30].

We also expected the Carstairs index, which suggests an average neighborhood income, would be a potential factor for EMR treatment rate. However, the results showed no significance among Carstairs index groups and EMR rate. In contrast to our study, a previous study demonstrated an association between neighborhood socioeconomic status and early screening of cancer [21].

In terms of subgroup analysis by gender, the EMR treatment rate of men in the lowest income group was significantly lower than those in the highest income group, whereas there was no significant difference in the EMR treatment rate of women among income groups. The rate of receiving EMR treatment was lower for women (18.2 %) than for men (19.4 %). Because of psychological differences between men and women, women tend to have a higher barrier to being screened for cancer [31, 32]. We also analyzed subgroups of year of receiving EMR treatment, from late 2011 to 2013. In 2013, there was a significant difference between the EMR treatment rate of the lowest income group and highest income group. Because there were not enough participants, the results did not reveal significant differences.

Our study has some strengths and limitations.

Of note, we observed that income level has a significant effect on the rate of early cancer screening. This is one of a few studies of the accessibility of EMR treatment after the addition of EMR to insurance coverage in Korea, and we studied a relatively large sample despite the short period of time since the change in policy. Because the National Health Insurance of Korea covers all Koreans, a study based on data from HIRA can be considered a complete enumeration.

However, the size of the sample in this study is smaller than that of many general studies about cancer treatments because the period that we investigated was relatively

Table 4 Adjusted odds ratios for each demographic group for treatment with endoscopic mucosal/submucosal resection by gender subgroups

	Men			Women		
	OR	95 % CI	*p* value	OR	95 % CI	*p* value
Income						
Lowest	0.37	(0.19–0.74)	0.005	0.96	(0.47–1.96)	0.916
Low-middle	1.02	(0.68–1.53)	0.940	1.11	(0.57–2.15)	0.769
Middle-high	0.88	(0.61–1.27)	0.505	1.68	(0.97–2.91)	0.066
Highest	1.00			1.00		
Age (years)						
<50	1.00			1.00		
50–59	1.41	(0.78–2.57)	0.260	1.31	(0.60–2.86)	0.492
60–69	2.20	(1.22–3.97)	0.009	2.38	(1.08–5.23)	0.031
≥70	1.51	(0.83–2.73)	0.178	1.22	(0.55–2.70)	0.619
Residential area						
Non-metropolitan	1.07	(0.77–1.47)	0.704	1.17	(0.72–1.91)	0.533
Metropolitan	1.00			1.00		
Hypertension						
No	1.00			1.00		
Yes	1.08	(0.77–1.50)	0.673	1.26	(0.74–2.14)	0.400
Diabetes						
No	1.00			1.00		
Yes	0.87	(0.62–1.23)	0.432	0.84	(0.50–1.42)	0.519
Disabled status						
No	1.00			1.00		
Yes	0.59	(0.36–0.96)	0.034	1.49	(0.74–3.00)	0.268
Year						
2011	1.00			1.00		
2012	1.42	(0.95–2.12)	0.088	1.41	(0.76–2.61)	0.275
2013	1.15	(0.75–1.75)	0.521	1.24	(0.66–2.32)	0.503
Hospital level						
Tertiary hospitals	1.00			1.00		
Secondary hospitals	0.43	(0.20–0.92)	0.029	0.22	(0.05–0.93)	0.040
Primary clinics	0.39	(0.21–0.73)	0.003	0.29	(0.11–0.76)	0.012
Carstairs index						
Low (the least deprived)	1.00			1.00		
Middle	1.10	(0.75–1.61)	0.642	0.93	(0.54–1.58)	0.780
High (the most deprived)	1.23	(0.85–1.79)	0.270	0.72	(0.40–1.28)	0.266

OR odds ratio for endoscopic mucosal/submucosal resection (EMR), *CI* confidence interval for EMR

short. Nevertheless, the number of patients we investigated is the same as the number of actual gastric cancer patients in Korea, making our data valuable. According to Statics Korea, the incidence rates of gastric cancer in 2011 and 2012 were 63.5 persons per 100,000 population and 61.3 persons per 100,000 population, respectively. These rates are nearly the same as the figures in our study, and therefore this study presents an accurate overview of gastric cancer in Korea.

Other limitations still exist, as described next. First, we could not conduct a cohort study design because of the short follow-up period. Second, as our study shows, some of the variables expected to have a significant effect, such as the Carstairs index, did not show a significant difference. Third, the exact mechanisms are still unknown. Although we described the possibility that late cancer detection in low-income groups is associated with a low rate for EMR, we still need to investigate other mechanisms from social and cultural aspects.

Thus, further studies are necessary to account for the short sample period and the small sample size in this study.

Conclusion

This study supports the association between rate of treatment with EMR and income level of patients. Patients of the highest income level are much more likely to undergo EMR treatment than those of the lowest income level. In addition, according to the subgroup analysis by gender, there is a greater association between income and EMR treatment rate among men than among women. In conclusion, we suggest that, although medical insurance began covering EMR treatment in 2011, patients of the lowest level of income are still less likely to receive treatment with EMR.

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Compliance with ethical standards

Conflict of interest There is no conflict of interest.

Ethical approval All authors are approved to use the data, and the ethical board of Graduate School of Public Health in Yonsei University granted this study (2-1040939-AB-N-01-2014-239).

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