Research article

The association between bladder-emptying methods and health-related quality of life among Iranian individuals with spinal cord injury

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Objectives: In this study, we compared the health-related quality of life (HRQoL) among patients with spinal cord injury (SCI) using different bladder emptying methods including normal spontaneous micturition (NSM), micturition with assisted maneuvers (MAM), aseptic intermittent catheterization by patient (IC-P), aseptic IC by an attendant/caregiver (IC-A) and indwelling catheterization.

Design: Cross-sectional.

Setting: Tertiary rehabilitation center.

Participants: Patients referred to Brain and Spinal Cord Injury Research Center between 2012 and 2014.

Outcome measures: HRQoL was assessed by Short Form Health Survey (SF-36). Hierarchical regression analysis with adjustment for probable confounders (demographic and injury-related variables) was performed to assess the relationship between bladder-emptying method and total SF-36 score.

Results: Patients with injury at cervical sections had significantly lower scores in domain of physical functioning (PF), physical component summary (PCS) and total score ($P: 0.001$, <0.0001 and 0.027 , respectively). Longer time since injury was associated with better scores of PCS, Mental component summary (MCS) and total score ($P: 0.002$, <0.0001 and 0.003 , respectively). Regression analysis showed that the effect of bladder-emptying method on total score of SF-36 was significant ($P < 0.0001$) and this relationship remained significant after adjustment for probable confounders in the second step of hierarchical regression analysis ($R: 0.923$, $R^2: 0.852$, Adjusted $R^2: 0.847$, $P < 0.0001$). Patients with NSM had the highest scores in SF-36 instrument and individuals with indwelling catheterization had the poorest HRQoL in all domains.

Conclusion: This study shows that the type of bladder management method affects HRQoL significantly in patients with SCI. Intermittent catheterization are recommended to be administered instead of indwelling catheterization to improve HRQoL.

Keywords: Spinal cord injury, Quality of life, Urinary incontinence

Introduction

Along with increased life-expectancy after spinal cord injury (SCI), health-related quality of life (HRQoL) has become an important issue in the process of rehabilitation. Living with disability is a life-long process and injured individuals have to deal with various sets of

problems.¹ Neurogenic bladder (NB) dysfunction is a known complication after SCI which can be accompanied with incontinence, renal impairment and urinary tract infection (UTI).² Urologic complications including UTI, upper and lower urinary tract deterioration, and bladder or renal stones are commonly observed among patients with SCI.³ Therefore, proper bladder management is clinically essential to prevent urologic complications in people with SCI. It has been

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demonstrated that an efficient bladder management program is associated with improved quality of life (QoL) in people with SCI.⁴ Bladder dysfunction significantly decreases well-being in the affected individuals.² The management of NB dysfunction is a crucial component of a rehabilitation program in SCI.⁵ In order to better understand and promote physical, psychological and social well-being after SCI, it is important to identify the variables that affect QoL. In this regard, different methods for bladder management may influence QoL in patients with SCI. Previously, reduced QoL in all health domains in individuals with SCI using clean intermittent catheterization compared to healthy controls have been shown by Oh *et al.*⁶ Moreover, the association between impaired bladder control and lower QoL has been also reported by Hicken *et al.*⁷ In the present investigation, we tried to compare the effect of different bladder management methods on HRQoL in Iranian patients with SCI. Different bladder-emptying methods can be categorized in five groups as follows: normal spontaneous micturition (NSM), micturition with assisted maneuvers (MAM), aseptic intermittent catheterization by patient (IC-P), aseptic IC by an attendant/caregiver (IC-A) and indwelling catheterization. Here, we compared the HRQoL assessed by Short Form Health Survey (SF-36) between patients with SCI using different bladder-emptying methods. It has been demonstrated by Akkoç *et al.*⁸ that patients with normal spontaneous micturition have the highest HRQoL whereas the poorest QoL has been observed among patients with IC-A. Furthermore, previous studies have also confirmed the negative impact of incontinence on QoL.⁹ The association between bladder management method and QoL has not yet been described among Iranian population with SCI. Since QoL is influenced by various factors including community characteristics, it is essential to evaluate HRQoL in different cultures to confirm previous findings. To our knowledge, this is the first study investigating the correlation between bladder management method and HRQoL among Iranian patients with SCI.

Material and methods

Study design and participants

The present study is a cross-sectional investigation designed to determine the correlation between bladder management method and HRQoL in Iranian individuals with SCI. Participants were referred patients to Brain and Spinal Cord Injury Research Center which is a tertiary rehabilitation center. Individuals with SCI were invited to participate in the investigation based

on the following inclusion criteria: traumatic spinal cord injury and post injury duration longer than 1 year. Patients were excluded based on the following exclusion criteria: coincidental brain injury, pregnancy, non-traumatic SCI etiology, history of other coincidental chronic diseases (e.g. diabetes, cardiovascular disease, renal failure, liver dysfunction, endocrine diseases, rheumatologic diseases, cancer and etc.) and history of psychiatric diseases. Any noticeable comorbidities including organ failure, amputation, pressure ulcers, obesity and etc. were considered as exclusion criteria. Those with habit history of addiction to illegal drugs and cigarette smoking were excluded as well. The protocol of the study was approved by ethics committee of Tehran University of Medical Sciences. Data was collected between September 2012 and August 2014.

Demographic and spinal cord injury variables

Patients' age, sex and time since injury were assessed during interviews. The level of spinal injury was determined by magnetic resonance imaging and neurologist confirmation. Completeness was classified as either complete (no preserved sensory or motor function) or incomplete (variable motor function preserved below the neurological level of injury).^{10,11} Patients were classified according to American Spinal Cord Injury Association Scale (ASIA)¹² in which ASIA-A indicates complete injury with no preserved motor or sensory function below the neurological level. ASIA-B describes incomplete injury in which only sensory function is preserved. ASIA-C illustrates preserved motor function in which more than half of key muscles below the neurological level have a muscle grade <3. ASIA-D indicates preserved motor function in which at least half of key muscles below the neurological level have a muscle grade of 3 or more.

Bladder management method

Bladder-emptying method was asked during interviews and patients were categorized into the following groups: normal spontaneous micturition (NSM), micturition with assisted maneuvers (MAM), aseptic intermittent catheterization by patient (IC-P), aseptic intermittent catheterization by an attendant/caregiver (IC-A) and indwelling catheterization. Urologic consult was requested for all patients and the method of bladder management was suggested by an expert urologist based on patients' independence, hand function to set the catheter, having care givers, patients' ability to urinate without using catheterization, existence of neurogenic bladder, patients' preference and finally if necessary, urodynamic data.

Health-related quality of life

HRQoL was assessed using SF-36 questionnaire. This instrument is a standard measurement tool for assessment of HRQoL. The psychometric properties of the Iranian version of SF-36 questionnaire along with its validity and reliability are well documented.¹³ It has been shown by Montazeri *et al.*¹³ and Motamed *et al.*¹⁴ that the Persian version of SF-36 questionnaire is a reliable assessment tool to be used in Iranian population. The acceptable reliability of the Persian version of SF-36 questionnaire in Iranian patients with Major thalassemia has also been demonstrated by Jafari *et al.*¹⁵ This measurement tool includes 36 items which assess QoL in eight domains: physical functioning (PF), role limitation due to physical problems (RP), bodily pain (BP), general health perceptions (GH), vitality (VT), social functioning (SF), role limitation due to emotional problems (RE) and mental health (MH). These scales provide two component summary scores: physical component summary (PCS) and mental component summary (MCS). Scores range from 0 to 100 and higher scores are representative of better QoL. PCS includes domains of physical functioning, role limitation due to physical problems, bodily pain and general health. MCS includes domains of vitality, social functioning, role limitation due to emotional problems and mental health.¹⁶ The SF-36 questionnaire has been widely used in patients with SCI worldwide and is known to be a reliable tool to be used among individuals with SCI.^{17–20} The suitability of psychometric properties of Persian version SF-36 to be used among Iranian patients with SCI have been demonstrated by Ebrahimzadeh *et al.*^{21,22} and the published literature assessing HRQoL in individuals with SCI in Iran has frequently used SF-36 instrument.²³

Statistical analysis

Categorical variables are presented with percentages and values of continuous variables are described with mean $\pm$ standard deviation. Comparison of means was performed using independent *t*-test when there were two subgroups. By three or more subgroups, comparison of means was performed using one-way analysis of variance (ANOVA). Sheffé post hoc test was also performed following ANOVA to determine the subgroup in which values differ significantly from other subgroups. Linear regression analysis was used to assess the association between SF-36 domains and bladder management methods. Since many factors including demographic and injury-related variables (sex, injury level, plegia type and time since injury) have been shown to affect HRQoL,²¹ we used hierarchical

regression analysis with adjustment for these confounders to assess the effect of bladder management method on total score of SF-36. The relationship between categorical values was assessed using Pearson χ^2 test. $P < 0.05$ was considered statistically significant. All analysis was performed using SPSS software version 21 (IBM Corp, Armonk, NY, USA).

Results

Total of 171 patients (135 men and 31 women) participated in this investigation. Mean age of men and women were 47.04 ± 14.98 and 49.56 ± 14.48 , respectively ($P: 0.36$). The most prevalent injury level was injury at thoracic sections ($n: 84, 49.1\%$) followed by injuries at lumbar sections ($n: 50, 29.2\%$). Most patients had complete injury (ASIA-A) ($n: 127, 74.3\%$). Demographic and baseline characteristics of the study population have been presented in Table 1. Mean time since injury was 55.39 ± 18.75 months in men and 54.0 ± 18.77 months in women ($P: 0.69$). The most commonly used bladder-emptying method was IC-P ($n: 46, 26.9\%$) followed by IC-A and MAM ($n: 41, 24.0\%$). Twenty patients were using indwelling catheterization ($n: 20, 11.7\%$).

Men had significantly better scores in domain of social functioning and bodily pain ($P: 0.031$ and 0.018 , respectively). Furthermore, patients with injury at cervical level had significantly lower scores in domain of physical functioning ($P: 0.001$), role limitation due to physical problems ($P: 0.021$), physical component summary ($P < 0.0001$) and total score of SF-36 ($P: 0.027$) (Table 3). Similarly, lower scores in domains of PF, RP and PCS have been observed in patients with tetraplegia compared to paraplegic individuals ($P: 0.006, 0.021$ and 0.011). Total score of SF-36 was significantly higher in patients with paraplegia compared to tetraplegic subjects ($P: 0.044$) but the effect of injury completeness on HRQoL was insignificant (Table 4). The effects of sex and injury-related variables on HRQoL have been shown in Tables 2, 3 and 4. In the next step of the analysis, we used hierarchical regression analysis with adjustment for the above mentioned demographic and injury-related variables to assess the relationship between bladder management method and HRQoL. The effect of age on PCS, MCS and total SF-36 score was insignificant ($P: 0.25, 0.55$ and 0.62 , respectively). Therefore, age was not considered as a confounder in regression analysis. Although the effect of sex on total score of SF-36 was insignificant by independent *t*-test (Table 2), we still included sex as a confounder in regression analysis because numerous investigations support the existence of a sex-difference

Table 1 Demographic and spinal cord injury-related variables in Iranian individuals with spinal cord injury participated in this study

Variable	Subgroup	Frequency (percentage)	Mean $\pm$ Standard Deviation
Age (years)		-	47.57 $\pm$ 14.87
Sex	Men	135 (78.9)	-
	Women	36 (21.1)	-
Time since injury (months)		-	55.09 $\pm$ 18.70
Injury level	Cervical	37 (21.6)	-
	Thoracic	84 (49.1)	-
	Lumbar	50 (29.2)	-
Completeness of the injury	Complete	127 (74.3)	-
	Incomplete	44 (25.7)	-
ASIA score	A	127 (74.3)	-
	B	24 (14.0)	-
	C	14 (8.2)	-
	D	6 (3.5)	-
Plegia type	Paraplegia	136 (79.5)	-
	Tetraplegia	35 (20.5)	-
Bladder-emptying method	NSM	23 (13.5)	-
	MAM	41 (24.0)	-
	IC-P	46 (26.9)	-
	IC-A	41 (24.0)	-
	Indwelling C	20 (11.7)	-

ASIA: American Spinal Cord Injury Association, IC-A: Intermittent catheterization by an attendant/caregiver, IC-P: Intermittent catheterization by patient, Indwelling C: Indwelling catheterization, MAN: Micturition with assisted maneuvers, NSM: normal spontaneous micturition.

when addressing HRQoL.²⁴⁻²⁶ Longer time since injury was associated with better scores of PCS, MCS and total score (P : 0.002, < 0.0001 and 0.003, respectively). Regression analysis showed that the effect of bladder-emptying method on total score of SF-36 was significant (P < 0.0001) and this relationship remained significant after adjustment for probable confounders in the second step of hierarchical regression analysis (R : 0.923, R^2 : 0.852, Adjusted R^2 : 0.847, F change 4.69, P < 0.0001; Table 5). Histogram and normal P-P plot of regression analysis have been shown in Figs. 1 and 2. Further analysis with ANOVA showed that patients with normal spontaneous micturition had the highest scores in SF-36 instrument and individuals with

indwelling catheterization had the poorest HRQoL in all domains (Table 6).

Discussion

HRQoL is influenced by various factors including employment, social participation and independence.²⁷ The lower level of QoL has been frequently reported among individuals with SCI compared to healthy able-bodied people.²⁸⁻³¹ Recent advances in medical care enable patients with SCI to have a prolonged life-expectancy after SCI.³² Therefore, improving QoL has become a main goal during rehabilitation process. The close association between positive rehabilitation outcomes and high level of QoL has been suggested.³³ Thus,

Table 2 Health-related quality of life assessed by Short Form health survey (SF-36) in men and women with spinal cord injury

Domain	Men (n: 135) Mean (SD)	Women (n: 36) Mean (SD)	P-value [^]
Physical Functioning	28.13 (12.01)	21.95 (11.25)	0.18
Role limitation due to physical problems	65.15 (27.18)	68.14 (39.42)	0.49
Role limitation due to emotional problems	61.27 (23.02)	60.12 (38.60)	0.58
Mental Health	66.0 (13.08)	69.55 (18.08)	0.76
Vitality	72.5 (16.22)	65.92 (17.14)	0.22
Social Functioning	78.14 (19.43)	63.25 (18.39)	0.031*
Bodily Pain	65.63 (34.81)	54.15 (16.89)	0.018*
General Health	59.68 (25.16)	56.23 (18.64)	0.80
Physical Component Summary	55.22 (14.68)	53.04 (10.39)	0.92
Mental Component Summary	71.89 (17.05)	68.15 (13.11)	0.85
Total Score	63.18 (13.91)	60.28 (10.91)	0.27

SD: Standard Deviation.

[^]P-values stand for independent t -test to compare means between the two groups.

* Significance at the level of P < 0.05.

Table 3 The effect of injury level on health-related quality of life in patients with spinal cord injury

Domain	Cervical Mean (SD)	Thoracic Mean (SD)	Lumbar Mean (SD)	P-value [^]	Scheffe Post Hoc test subgroups	Scheffe Post hoc test significance
PF	19.08 (10.54)	32.45 (18.66)	39.09 (19.81)	0.001	Cervical* Lumbar	0.005
RP	49.72 (20.13)	60.22 (27.18)	71.28 (23.11)	0.021	Cervical* Thoracic	0.033
RE	60.08 (14.16)	59.30 (14.33)	61.28 (21.10)	0.48	Cervical* lumbar	0.047
MH	62.18 (19.21)	61.04 (10.56)	63.45 (12.78)	0.76	Cervical* Thoracic	0.024
VT	68.77 (20.31)	70.11 (13.29)	66.72 (18.64)	0.83	-	-
SF	71.87 (15.32)	74.94 (17.08)	69.46 (13.88)	0.11	-	-
BP	63.15 (22.06)	59.18 (24.10)	60.34 (19.02)	0.32	-	-
GH	58.32 (23.77)	57.44 (28.03)	55.97 (22.60)	0.22	-	-
PCS	42.01 (11.83)	58.12 (23.05)	67.07 (25.81)	<0.0001	Cervical* lumbar	<0.0001
MCS	67.08 (19.77)	70.19 (13.42)	69.98 (12.66)	0.19	Cervical* thoracic	0.024
Total Score	52.11 (25.40)	61.39 (18.12)	70.55 (20.18)	0.027	-	-
					Cervical*lumbar	0.029
					Cervical*thoracic	0.034

[^]P-values stand for One-way analysis of variance to compare means between subgroups.

BP: Bodily pain, GH: General health, MCS: Mental component summary, MH: Mental health, PCS: Physical component summary, PF: Physical functioning, RE: Role limitation due to emotional problems, RP: Role limitation due to physical problems, SD: Standard Deviation, SF: Social functioning, VT: Vitality.

identification of factors which influence QoL is clinically essential. Our study showed that the method of bladder management is an important factor affecting HRQoL. Patients with bladder-emptying methods that required less assistance from care-givers was associated with better QoL. On the other hand, higher level of dependency regarding bladder management (e.g. IC-A and indwelling catheterization) was correlated to poorer HRQoL in patients with SCI. Previously, Akkoç *et al.*⁸ reported that patients using IC-A have the poorest QoL compared to individuals using other methods for bladder management. In line with Akkoç *et al.*,⁸ our study showed that HRQoL was lower in patients using IC-A compared to subjects using NSM,

MAM and IC-P. However, patients with IC-A had better QoL compared to individuals using indwelling catheterization in our study which contradicts with Akkoç *et al.*⁸ outcomes. In fact, our study revealed that patients with indwelling catheterization have the poorest HRQoL. One reason for the poor quality of life in patients using indwelling catheterization can be due to the persistent unpleasant appearance of urine bag and urine tube which prohibits affected individuals to participate in social activities. Similar to our results, Sánchez Raya *et al.*³⁴ also detected the poorer HRQoL in patients using indwelling catheterization. Consistent with Sánchez Raya *et al.*,³⁴ our study also suggests that the bladder management method should

Table 4 The effect of injury completeness and plegia type on health-related quality of life

Domain	Injury Completeness			Plegia Type		
	Complete Mean (SD)	Incomplete Mean (SD)	P-value [^]	Paraplegia Mean (SD)	Tetraplegia Mean (SD)	P-value [^]
PF	23.01 (11.51)	29.90 (19.08)	0.38	28.60 (13.08)	14.07 (9.10)	0.006**
RP	67.43 (30.12)	72.48 (35.17)	0.60	70.48 (22.98)	55.16 (18.22)	0.021*
RE	59.83 (22.01)	64.25 (30.42)	0.08	63.13 (17.90)	61.20 (15.32)	0.40
MH	76.39 (19.06)	74.57 (13.12)	0.82	75.21 (23.05)	71.09 (31.26)	0.86
VT	70.55 (15.81)	68.74 (20.09)	0.45	69.14 (12.40)	73.10 (24.09)	0.44
SF	79.34 (18.23)	80.35 (23.30)	0.87	80.36 (30.21)	75.25 (27.31)	0.19
BP	71.57 (28.11)	68.96 (16.22)	0.73	76.97 (35.02)	72.60 (28.18)	0.92
GH	54.72 (25.16)	59.23 (29.15)	0.13	57.13 (33.09)	50.48 (30.91)	0.66
PCS	58.20 (17.92)	54.01 (10.44)	0.25	65.20 (29.38)	46.17 (23.12)	0.011*
MCS	74.29 (21.63)	70.63 (28.11)	0.63	73.50 (25.66)	68.19 (23.86)	0.33
Total Score	60.70 (20.13)	63.92 (14.98)	0.38	76.27 (14.80)	59.05 (17.10)	0.044*

[^]P-values stand for independent t-test to compare means between the two groups.

BP: Bodily pain, GH: General health, MCS: Mental component summary, MH: Mental health, PCS: Physical component summary, PF: Physical functioning, RE: Role limitation due to emotional problems, RP: Role limitation due to physical problems, SD: Standard Deviation, SF: Social functioning, VT: Vitality.

* Significance at the level of P < 0.05.

** Significance at the level of P < 0.01.

Table 5 Hierarchical regression analysis with controlling for sex, injury level, plegia type and time since injury to assess the relationship between bladder management method and total score of SF-36 questionnaire (Dependent variable: total score of SF-36 questionnaire)

	B	Beta	t	p-value	R	R ²	Adjusted R ²	R ² Change	F change	P-value
Step 1	-	-	-	-	0.914	0.835	0.834	0.835	855.26	<0.0001
BMM	-13.136	-0.914	-29.24	<0.0001	-	-	-	-	-	-
Step 2	-	-	-	-	0.923	0.852	0.847	0.017	4.692	0.001
BMM	-13.01	-0.906	-29.66	<0.0001	-	-	-	-	-	-
Sex	-0.013	0.001	-0.10	0.99	-	-	-	-	-	-
Injury level	2.584	0.105	2.541	0.012	-	-	-	-	-	-
Plegia type	-6.600	-0.141	-3.417	0.001	-	-	-	-	-	-
TSI	0.078	0.083	2.722	0.007	-	-	-	-	-	-

BMM: Bladder management method, TSI: Time since injury.

be shifted toward intermittent catheterization in patients who use indwelling catheterization in order to improve HRQoL. Furthermore, Pannek & Kullik³⁵ showed that fears and feelings were significantly worse in patients with suboptimal bladder function and therefore probable treatments to obtain favorable urodynamic data should be considered in the rehabilitation process to improve QoL in people with SCI.

Intermittent catheterization (IC) has been accepted as the standard and appropriate procedure for managing the NB in patients with SCI.^{36,37} According to Bakke *et al.*,³⁸ personal attitude assessment shows some extents of dissatisfaction and aversive reactions toward IC especially among women with SCI. Although our study suggests administering IC instead of indwelling catheterization, proper interventions should be also considered to improve personal attitude to IC and to make IC more acceptable by patients.

HRQoL is tremendously changed after SCI due to numerous complications including neurogenic bladder. In this regard, it has been demonstrated that effect on HRQoL from the use of IC is likely to be generally

better than that of other bladder management methods.³⁹ Our study showed that patients who had the ability of NSM or MAM had the highest HRQoL and those patients who were able to perform IC themselves had better QoL compared to those individuals who were dependent to a care giver. Although NSM and MAM are associated with better HRQoL, many individuals especially those with injury at cervical sections suffer from NB and cannot use NSM and MAM for bladder management. Furthermore, many patients who have quadriplegia suffer from impaired hand function and need a care giver to perform IC. It can be concluded that many methods for bladder management (e.g. NSM and MAM) cannot be applied for the majority of individuals with SCI to improve QoL. Moreover, administration of IC is preferred rather than indwelling catheterization and has the potential to improve HRQoL in all health domains.

Figure 1 Histogram: Dependent Variable: Total SF-36 Score**Normal P-P Plot of Regression Standardized Residual**
Dependent Variable: Total SF-36 Score **Figure 2** Normal P-P Plot of Regression Standardized Residual

Table 6 The relationship between bladder management methods and domains of health-related quality of life as assessed by one-way analysis of variance (ANOVA)

Domain	NSM Mean (SD)	MAM Mean (SD)	IC-P Mean (SD)	IC-A Mean (SD)	Indwelling C Mean (SD)	P-value
PF	42.0 (19.17)	31.42 (18.31)	27.47 (18.37)	20.25 (14.82)	14.90 (10.28)	0.001
RP	80.48 (31.87)	76.08 (28.78)	51.10 (29.07)	46.20 (23.50)	27.50 (12.38)	<0.0001
RE	93.33 (25.81)	89.32 (23.05)	60.61 (34.69)	41.66 (27.40)	29.30 (16.50)	<0.0001
MH	85.06 (11.49)	80.71 (15.46)	74.70 (17.28)	68.22 (21.15)	59.81 (19.29)	<0.0001
VT	84.33 (12.65)	73.70 (11.61)	68.11 (13.50)	60.21 (14.80)	54.40 (18.63)	<0.0001
SF	93.75 (14.43)	87.74 (15.35)	75.46 (21.22)	64.16 (25.81)	56.81 (19.65)	<0.0001
BP	86.71 (15.24)	76.37 (20.32)	70.51 (22.68)	59.82 (29.12)	50.31 (37.08)	0.004
GH	70.0 (16.20)	66.10 (17.43)	55.52 (27.93)	48.39 (20.25)	40.67 (12.88)	<0.0001
PCS	74.90 (17.83)	65.08 (8.55)	57.52 (16.43)	50.67 (21.17)	31.25 (10.90)	<0.0001
MCS	90.63 (8.90)	84.76 (7.96)	64.04 (16.61)	56.53 (17.25)	48.40 (13.32)	<0.0001
Total Score	85.36 (3.69)	75.24 (3.79)	61.00 (8.55)	52.12 (7.99)	39.25 (4.89)	<0.0001

BP: Bodily pain, GH: General health, MCS: Mental component summary, MH: Mental health, PCS: Physical component summary, PF: Physical functioning, RE: Role limitation due to emotional problems, RP: Role limitation due to physical problems, SD: Standard Deviation, SF: Social functioning, VT: Vitality.

Our study also showed that patients with higher injury level (at cervical sections) have poorer QoL especially in domain of physical functioning. Similar results have been reported by Sabour *et al.*⁴⁰ and injury level has been demonstrated as a major determinant of QoL. Furthermore, Jain *et al.*⁴¹ also showed that higher injury level and complete injuries are associated with poorer QoL which is in line with our study. No significant effect of injury completeness on HRQoL could be detected in our study. Consistent with our results, insignificant influence of injury completeness on QoL has been reported previously by Fuhrer *et al.*⁴² and Taghipoor *et al.*⁴³ Altogether, it can be concluded that injury level is a major factor affecting QoL whereas injury completeness does not seem to play an important part in determining HRQoL. Among other injury-related variables, longer time since injury was associated with better HRQoL which in line with previous findings reported by Geyh *et al.*⁴⁴ Furthermore, Wijesuriya *et al.*⁴⁵ showed that a shorter time since injury was significantly associated with higher levels of fatigue among individuals with SCI. It seems that fatigue may be a factor contributing to the lower HRQoL in patients with shorter time since injury.

One of the strong points of this study is recruitment of a homogenous study population to omit the effect of various comorbidities on HRQoL. Here, we excluded those patients with coincidental chronic diseases. Any noticeable comorbidity was considered as an exclusion criterion. Different comorbidities may affect the bladder management method and may end up in the obligation of using indwelling catheterization. In order to understand whether the reduced HRQoL is comorbidity-induced or is a result of indwelling catheterization, it was essential to omit those participants with comorbidities to attain a homogenous study population.

Study limitation

Lack of evaluation of urodynamic data is the major limitation of this study. We recommend that future studies with consideration the urodynamic data be performed to clarify more details about the association between bladder management and HRQoL in patients with SCI. The Persian version of SF-36 questionnaire has been validated to be used in general population of Iran. Although many studies have proven that this questionnaire is valid and reliable to be used in people with SCI, it is recommended that further investigations validate the psychometric properties of the Persian version of this instrument in Iranian people with SCI.

Conclusion

This study shows that the type of bladder management method affects HRQoL significantly in patients with SCI. Intermittent catheterization are recommended to be administered instead of indwelling catheterization to improve HRQoL.

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