**Principle Component Analysis of Health–Related Quality of Life Measures for Prostate Cancer**

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**Objective:** The aim of this study is to elucidate underlying distinctive common features of currently used measures.

**Patients:** This study was conducted as a part of nationwide cross-sectional and observational study of "Prostate cancer background, quality of life (QOL), patient’s satisfaction and treatment survey by Japan Prostate Cancer Study Group (J-CaP)". PCa survivors were invited to answer Short Form 36 (SF-36), Expanded Prostate Cancer Index Composite (EPIC), Functional Assessment of Cancer Therapy (FACT) through the web page of J-CaP.

**Methods:** Significant conceptual components of three health–related quality of life (HRQoL) questionnaires: EPIC, FACT, and SF–36 were identified by principle component analysis in Japanese patients.

**Results:** All of the questions from EPIC, FACT, and SF–36 were classified into 9 categories by principle component analysis. Our result suggests that a more feasible and integrated HRQoL measure can be created based on those components identified in our study.

**Conclusion:** Three HRQoL questionnaires containing 128 questions in total could be narrowed down to 9 principle components. Our future assignment is to create an integrated and more feasible version of scoring system that comprehensively covers these 9 components.

**Key words:** health–related quality of life (HRQoL), Expanded Prostate Cancer Index Composite (EPIC), Functional Assessment of Cancer Therapy (FACT), Short Form 36 (SF–36), principle component analysis

**Introduction**

In today’s aging society, prevalence of prostate cancer (PCa) is on the rise worldwide. However, despite its high prevalence, PCa is highly curable especially when the disease is organ–confined. Furthermore, we have a variety of treatment options, including radical surgery, radiotherapy, hormonal therapy and chemotherapy. Hormonal therapy and taxane–based chemotherapy have been proven to improve prognosis of patients with metastatic PCa.

Meanwhile, side effects of each treatment can profoundly impact cancer survivors’ health–related quality of life (HRQoL) even after recovery from the disease itself, since they tend to be rather long–lasting and wide–ranging. In particular, complications of surgery include sexual dysfunction and incontinence, and radiotherapy can induce bladder irritation and rectal hemorrhage. Hormonal therapy often accompanies more systemic side effects such as depression, sarcopenia, in addition to sexual dysfunction.

Therefore, it is of paramount importance in...
clinical setting to objectively evaluate the influence of treatment–related adverse effects on HRQoL. To date, several measures have been developed to assess patients’ HRQoL during and after prostate cancer treatments. Among them, we focused on the following three representative scoring systems: the Expanded Prostate Cancer Index Composite (EPIC)\(^2\), Short Form 36 (SF-36)\(^3\), and Functional Assessment of Cancer Therapy (FACT) quality of life measurement system\(^4\)\(^5\). Each scoring system comprises a variety of questions to comprehensively assess patients’ HRQoL; 51 questions for EPIC, 41 questions for FACT, and 36 questions for SF-36, respectively. EPIC differs from FACT and SF-36 in providing distinct, physically specific scores for urinary, bowel, sexual, and hormonal symptoms. Meanwhile, FACT and SF-36 are used to assess more general health status and HRQoL. Although they are well-designed measures, it is cumbersome and time-consuming to fill in all of these questionnaires. Thus, we surmised that more comprehensive and feasible measure can be created by combining above three scoring systems. To this end, we utilized principle component analysis (PCA) to elucidate underlying concepts of each scoring system.

**Patients and methods**

This study was conducted as a part of nationwide cross-sectional and observational study of “Prostate cancer background, QOL, patient’s satisfaction and treatment survey by Japan Prostate Cancer Study Group (J–CaP)” (UMIN000004666). J–CaP registry is a large, multicenter, population–based database. PCa survivors were invited to answer SF–36, EPIC, FACT through the web page of J–CaP. All participants are managed by IDs in order to prevent duplicate answering.

Principle component analysis (PCA) is a statistical procedure that is often used for exploratory data analysis or construction of predictive models. Its basic notions and equations are explained in detail elsewhere\(^6\). In plain words, PCA enables broad classification of seemingly unrelated multiple factors and elucidation of common denominator. Eigenvalue, cumulative contribution ratio and scree plot determine the reasonable number of principle components such that more than 50% of overall variance can be explained. Then, Varimax rotation was used to extract the appropriate number of components for each analysis, followed by Bartlett’s test of sphericity to give principle component score to each question. In the end, a group of questions in each component that yielded principle component score ≥0.5 (absolute value) is regarded to present representative concept in that component, and named accordingly depending on the type of questions it contains. SPSS statistical software v23 was used for the analysis. Individual background factors are not considered in this study. Because the purpose of this study is to extract principle components of 3 questionnaires based on tendency of answering patterns, not on relation between background factors and answers. All statistical analyses in this study were conducted by a professional statistician (author ZH).

**Results**

One hundred PCa survivors answered SF–36, while 48 and 34 answered EPIC and FACT, respectively. PCA was conducted to visualize similarity in questions of each scoring system. In short, PCA enables classification of scoring pattern among participants. For instance, if a certain subset of questions shows a similar scoring distribution among participants, those questions will be categorized into the same component.

Regarding EPIC, the scree plot indicated that the extraction of 3–5 components are reasonable (Figure–1). Since 4 components reasonably explain more than 51.9% of overall variance, we decided to

![Figure-1](image-url)
Table 1: A PCA projection of 51 questions from EPIC

| Overall, how big a problem has your urinary function been for you during the last 4 weeks? | 0.789 | -0.091 | -0.054 | 0.136 |
| A problem during the last 4 weeks: Need to urine frequently during the day | 0.775 | -0.11 | -0.04 | -0.161 |
| A problem during the last 4 weeks: Dripping or leaking urine | 0.768 | -0.056 | 0.202 | -0.117 |
| During the last 4 weeks, how often have you felt a lack of energy? | -0.732 | 0.2 | -0.12 | -0.194 |
| A problem during the last 4 weeks: lack of energy | 0.724 | -0.2 | 0.066 | 0.2 |
| During the last 4 weeks, how often have you felt depressed? | -0.715 | -0.013 | -0.206 | -0.166 |
| Over the past 4 weeks, how often have you leaked urine? | -0.691 | -0.02 | 0.089 | 0.039 |
| How many pads or adult diapers per day did you usually use to control leakage during the last 4 weeks? | 0.664 | 0.072 | -0.153 | 0.041 |
| A problem during the last 4 weeks: Weak urine stream | 0.635 | -0.021 | 0.197 | -0.067 |
| A problem during the last 4 weeks: Hot flashes | 0.601 | -0.329 | 0.03 | 0.315 |
| Over the last 4 weeks, how often have you experienced hot flashes? | -0.578 | 0.298 | -0.014 | -0.269 |
| A problem during the last 4 weeks: Feeling depressed | 0.549 | -0.131 | 0.216 | 0.361 |
| A problem during the last 4 weeks: Waking up to urine | 0.547 | -0.253 | -0.109 | -0.178 |
| Which of the following best describes your urinary control during the 4 weeks? | -0.503 | 0.096 | -0.095 | -0.445 |
| A problem during the last 4 weeks: Breast tenderness/enlargement | 0.487 | 0.049 | 0.042 | 0.124 |
| How often have you had breast tenderness during the last 4 weeks? | -0.394 | -0.022 | -0.032 | -0.194 |
| Overall, how satisfied are you with the treatment you received for your prostate cancer? | -0.391 | -0.125 | -0.38 | 0.068 |
| How would you describe the usual QUALITY of your erection during the last 4 weeks? | -0.316 | 0.814 | -0.072 | 0.041 |
| How would you describe the usual FREQUENCY of your erection during the last 4 weeks? | -0.303 | 0.814 | -0.124 | -0.063 |
| How would you rate your ability to reach orgasm during the last 4 weeks? | -0.222 | 0.814 | 0.088 | 0.131 |
| How would you rate your level of sexual desire during the last 4 weeks? | 0.16 | 0.814 | 0.064 | -0.071 |
| Overall, how would you rate your ability to function sexually during the last 4 weeks? | 0.142 | 0.788 | -0.149 | 0.052 |
| How would you rate your ability to have an erection during the last 4 weeks? | -0.301 | 0.775 | -0.129 | 0.284 |
| During the last 4 weeks, how often did you have any sexual activity? | -0.359 | 0.728 | -0.013 | -0.054 |
| During the last 4 weeks, how often did you have sexual intercourse? | -0.273 | 0.624 | -0.127 | 0.085 |
| A problem during the last 4 weeks: Your level of sexual desire | 0.345 | 0.605 | 0.198 | -0.228 |
| How often have you awakened in the morning or night with an erection during the last 4 weeks? | -0.005 | 0.547 | -0.277 | 0.341 |
| A problem during the last 4 weeks: Change in body weight | 0.113 | -0.307 | 0.259 | 0.108 |
| A problem during the last 4 weeks: Your ability to reach an orgasm. | -0.015 | 0.479 | 0.29 | -0.341 |
| A problem during the last 4 weeks: Your ability to have an erection | 0.08 | 0.469 | 0.297 | -0.324 |
| Overall, how big a problem has your sexual function been for you during the last 4 weeks? | 0.41 | 0.468 | 0.457 | -0.321 |
| A problem during the last 4 weeks: Loss of body hair | 0.195 | -0.318 | -0.245 | 0.077 |
| How much change in your weight have you experienced during the last 4 weeks, if any? | 0.128 | 0.288 | -0.224 | 0.262 |
| A problem during the last 4 weeks: Urgency to have a bowel movement | 0.024 | -0.05 | 0.299 | 0.171 |
| A problem during the last 4 weeks: Losing control of your stools | 0.224 | -0.108 | 0.083 | 0.149 |
| A problem during the last 4 weeks: Increased frequency of bowel movements | 0.108 | -0.088 | 0.823 | 0.225 |
| A problem during the last 4 weeks: Watery bowel movements | -0.063 | 0.02 | 0.679 | 0.335 |
| Overall, how big a problem have your bowel habits been for you during the last 4 weeks? | 0.022 | 0.103 | 0.666 | 0.586 |
| How often haven you had rectal urgency during the last 4 weeks? | 0.054 | 0.262 | -0.017 | -0.055 |
| How often have you had stools that were loose or liquid during the last 4 weeks? | -0.052 | -0.031 | 0.548 | 0.478 |
| How many bowel movements have you had on a typical day during the last 4 weeks? | -0.128 | 0.119 | 0.528 | 0.013 |
| How often have you had bloody stools during the last 4 weeks? | 0.132 | -0.059 | 0.502 | -0.105 |
| A problem during the last 4 weeks: Bloody stools | 0.142 | -0.056 | 0.377 | -0.028 |
| A problem during the last 4 weeks: Bleeding in urination | 0.006 | -0.074 | 0.134 | 0.832 |
| Over the past 4 weeks, how often have you urinated blood? | -0.024 | -0.021 | 0.018 | -0.73 |
| How often have you had uncontrolled leakage of stool or feces? | 0.156 | -0.019 | -0.25 | -0.72 |
| A problem during the last 4 weeks: Abdominal/Pelvic/Rectal pain | 0.185 | -0.079 | 0.192 | 0.652 |
| A problem during the last 4 weeks: Pain or burning on urination | 0.215 | -0.062 | -0.06 | 0.604 |
| How often have you had crampy pain in your abdomen, pelvis or rectum during the last 4 weeks? | -0.232 | -0.048 | -0.069 | -0.603 |
| How often have your bowel movements been painful during the last 4 weeks? | 0.114 | 0.019 | 0.128 | 0.439 |
| Over the past 4 weeks, how often have you had pain or burning with urination? | -0.336 | 0.028 | 0.225 | -0.371 |

Each dot represents one question. Four principle components are extracted and named as indicated. Following 7 times of repetition, the rotation converged.
extract 4 principle components (Table-1). As a result, 51 questions of EPIC appeared to be classified into 4 distinct components. We surmised that questions that yielded principle component score $\geq 0.5$ (absolute value) in each component represent a concept of that component (Table-1). Depending on the type of questions included in the same group, we subjectively entitled each component as follows. Expectedly, by and large EPIC seemed to focus on following specific physical conditions related to prostate cancer.

1. Incontinence, hot flushes, lack of energy (color-coded as yellow)
2. Sexual functions (color-coded as red)
3. Problems with bowel movement (color-coded as blue)
4. Irritation at the time of urination, hematuria (color-coded as green)

Meanwhile, the scree plot of FACT indicated that the extraction of 3–4 components are reasonable (Figure–2). Three components are sufficient to explain 50.8% of overall variance. Consequently, 41 questions of FACT were categorized into the following 3 components, and entitled depending on the type of questions with principle component score $\geq 0.5$ (absolute value) (Table-2).

1. Anxiety, anguish (color-coded as yellow)
2. Intimacy with family members (color-coded as red)
3. Acceptance of illness, self-affirmation (color-coded as blue)

In terms of SF-36, the scree plot indicated that the extraction of 2–3 components are reasonable (Figure–3). Thus, we extracted 2 principle components, which reasonably explained more than 55.3% of overall variance. Resultant PCA projection showed that 36 questions were broadly divided into the following 2 distinct components (Table-3).

1. Vigorousness (color-coded as yellow)
2. No limitation in daily activity (color-coded as red)

Our result indicates that 128 questions from EPIC, FACT, and SF-36 broadly encompass 9 conceptual components related to HRQoL. In contrast to EPIC, FACT and SF-36 appeared to converge on more general health status and HRQoL, which is consistent with the original concept of each questionnaire.

Discussion

Prostate cancer is one of the most prevalent cancer among men. Clinical outcomes of organ-confined PCa have improved because of PSA screening, radical treatment such as surgery and radiotherapy in addition to the development of various medical treatments. Correspondingly, attention has shifted from mere curability toward maintaining HRQoL during and after treatments. Thus, it is of imminent necessity to evaluate HRQoL of cancer survivors before and after the courses of treatments. Three major scoring system of HRQoL; EPIC, FACT, and SF-36, have been developed and in use for this purpose. EPIC was designed to assess HRQoL concerns specific to the treatment of prostate...
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<table>
<thead>
<tr>
<th>Additional concerns: I have aches and pains that bother me</th>
<th>Principle component score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical well-being: I have pain</td>
<td>0.856 -0.172</td>
</tr>
<tr>
<td>Additional concerns: I have certain parts of my body where I experience pain</td>
<td>0.829 -0.016 -0.13</td>
</tr>
<tr>
<td>Additional concerns: My pain keeps me from doing things I want to do</td>
<td>0.824 -0.358 0.035</td>
</tr>
<tr>
<td>Functional well-being: I am able to work</td>
<td>-0.812 0.117 0.027</td>
</tr>
<tr>
<td>Functional well-being: I am able to enjoy life</td>
<td>-0.747 0.448 0.258</td>
</tr>
<tr>
<td>Physical well-being: I have nausea</td>
<td>0.692 -0.344 0.149</td>
</tr>
<tr>
<td>Additional concerns: I am satisfied with my present comfort level</td>
<td>-0.689 -0.006 0.27</td>
</tr>
<tr>
<td>Functional well-being: My work is fulfilling</td>
<td>-0.685 0.014 0.222</td>
</tr>
<tr>
<td>Physical well-being: I feel ill</td>
<td>0.642 -0.089 -0.125</td>
</tr>
<tr>
<td>Emotional well-being: I am losing hope in the fight against my illness.</td>
<td>0.627 -0.394 -0.041</td>
</tr>
<tr>
<td>Additional concerns: I have trouble moving my bowels</td>
<td>0.616 0.114 -0.312</td>
</tr>
<tr>
<td>Physical well-being: I am forced to spend time in bed</td>
<td>0.614 -0.087 -0.143</td>
</tr>
<tr>
<td>Physical well-being: I am bothered by side effects of treatment</td>
<td>0.562 -0.318 -0.013</td>
</tr>
<tr>
<td>Additional concerns: I urinate more frequently than usual</td>
<td>0.554 -0.255 -0.398</td>
</tr>
<tr>
<td>Physical well-being: Because of my physical condition, I have trouble meeting the needs of my family</td>
<td>0.511 -0.195 -0.062</td>
</tr>
<tr>
<td>Additional concerns: I am losing weight</td>
<td>0.444 0.371 -0.111</td>
</tr>
<tr>
<td>Physical well-being: I have a lack of energy</td>
<td>0.371 -0.343 -0.161</td>
</tr>
<tr>
<td>Social/Family well-being: I feel close to my partner (or the person who is my main support)</td>
<td>-0.083 0.786 -0.103</td>
</tr>
<tr>
<td>Social/Family well-being: I am satisfied with family communication about my illness</td>
<td>-0.251 0.751 -0.064</td>
</tr>
<tr>
<td>Social/Family well-being: I get emotional support from my family</td>
<td>0.089 0.733 0.23</td>
</tr>
<tr>
<td>Social/Family well-being: My family has accepted my illness</td>
<td>-0.517 0.709 -0.014</td>
</tr>
<tr>
<td>Social/Family well-being: My illness does not hamper my relationship with my family</td>
<td>-0.255 0.705 0.011</td>
</tr>
<tr>
<td>Social/Family well-being: I feel close to my family</td>
<td>-0.431 0.575 0.012</td>
</tr>
<tr>
<td>Social/Family well-being: I am satisfied with my sex life</td>
<td>0.066 0.574 0.476</td>
</tr>
<tr>
<td>Additional concerns: My problems with urinating limit my activities</td>
<td>0.364 -0.426 -0.09</td>
</tr>
<tr>
<td>Emotional well-being: I worry about dying</td>
<td>0.046 0.078 -0.751</td>
</tr>
<tr>
<td>Functional well-being: I have accepted my illness</td>
<td>-0.025 -0.013 0.666</td>
</tr>
<tr>
<td>Emotional well-being: I worry that my condition will get worse</td>
<td>0.077 -0.04 -0.612</td>
</tr>
<tr>
<td>Emotional well-being: I am satisfied with how I am coping with my illness</td>
<td>-0.001 0.206 0.612</td>
</tr>
<tr>
<td>Additional concerns: I am able to feel like a man</td>
<td>-0.068 0.354 0.568</td>
</tr>
<tr>
<td>Functional well-being: I am sleeping well</td>
<td>-0.387 0.077 0.563</td>
</tr>
<tr>
<td>Additional concerns: I have difficulty urinating</td>
<td>0.048 0.173 -0.543</td>
</tr>
<tr>
<td>Additional concerns: I have a good appetite</td>
<td>-0.376 -0.01 0.536</td>
</tr>
<tr>
<td>Emotional well-being: I feel sad</td>
<td>0.351 -0.291 -0.51</td>
</tr>
<tr>
<td>Functional well-being: I am content with the quality of my life right now</td>
<td>-0.426 0.452 0.494</td>
</tr>
<tr>
<td>Additional concerns: I am able to have and maintain an erection</td>
<td>-0.172 0.16 0.481</td>
</tr>
<tr>
<td>Social/Family well-being: I feel close to my friends</td>
<td>0.035 -0.046 0.469</td>
</tr>
<tr>
<td>Functional well-being: I am enjoying the things I usually do for fun</td>
<td>-0.43 0.156 0.454</td>
</tr>
<tr>
<td>Social/Family well-being: I get support from my friends</td>
<td>0.088 -0.195 0.445</td>
</tr>
<tr>
<td>Emotional well-being: I feel nervous</td>
<td>0.229 -0.264 -0.416</td>
</tr>
</tbody>
</table>

Three principle components are extracted and named as indicated. Following 6 times of repetition, the rotation converged.
Table 3  A PCA projection of 36 questions from SF-36

Matrix after Varimax rotation

<table>
<thead>
<tr>
<th>Question</th>
<th>Principle component score 1</th>
<th>Principle component score 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emotional health problems: Didn’t do work or other activities as carefully as usual</td>
<td>0.812</td>
<td>0.197</td>
</tr>
<tr>
<td>Physical health problems: Had difficulty performing the work or other activities (for example, it took extra effort)</td>
<td>0.792</td>
<td>0.348</td>
</tr>
<tr>
<td>Physical health problems: Accomplished less than you would like</td>
<td>0.773</td>
<td>0.437</td>
</tr>
<tr>
<td>Energy and emotions: Did you have a lot of energy?</td>
<td>-0.758</td>
<td>-0.221</td>
</tr>
<tr>
<td>Physical health problems: Were limited in the kind of work or other activities</td>
<td>0.757</td>
<td>0.321</td>
</tr>
<tr>
<td>Physical health problems: Cut down the amount of time you spent on work or other activities</td>
<td>0.753</td>
<td>0.396</td>
</tr>
<tr>
<td>General health: In general, would you say your health is</td>
<td>-0.742</td>
<td>-0.178</td>
</tr>
<tr>
<td>Social activities: During the past 4 weeks, how much did pain interfere with your normal work (including both work outside the home and housework)?</td>
<td>-0.725</td>
<td>-0.418</td>
</tr>
<tr>
<td>Emotional health problems: Accomplished less than you would like</td>
<td>0.707</td>
<td>0.386</td>
</tr>
<tr>
<td>Energy and emotions: Have you felt so down in the dumps that nothing could cheer you up?</td>
<td>0.705</td>
<td>0.063</td>
</tr>
<tr>
<td>Energy and emotions: Did you feel tired?</td>
<td>0.697</td>
<td>0.264</td>
</tr>
<tr>
<td>Energy and emotions: Have you felt downhearted and blue?</td>
<td>0.69</td>
<td>0.038</td>
</tr>
<tr>
<td>Emotional health problems: Cut down the amount of time you spent on work or other activities</td>
<td>0.685</td>
<td>0.288</td>
</tr>
<tr>
<td>Energy and emotions: Have you been a very nervous person?</td>
<td>0.672</td>
<td>0.041</td>
</tr>
<tr>
<td>Social activities: During the past 4 weeks, how much did pain interfere with your normal work (including both work outside the home and housework)?</td>
<td>-0.649</td>
<td>-0.135</td>
</tr>
<tr>
<td>General health: My health is excellent</td>
<td>-0.649</td>
<td>-0.206</td>
</tr>
<tr>
<td>Energy and emotions: Have you felt calm and peaceful?</td>
<td>-0.633</td>
<td>-0.092</td>
</tr>
<tr>
<td>General health: I am as healthy as anybody I know</td>
<td>-0.628</td>
<td>-0.311</td>
</tr>
<tr>
<td>Social activities: Emotional problems interfered with your normal social activities with family, friends, neighbors, or groups?</td>
<td>-0.613</td>
<td>-0.282</td>
</tr>
<tr>
<td>Compared to one year ago, how would you rate your health in general now?</td>
<td>-0.53</td>
<td>-0.194</td>
</tr>
<tr>
<td>Energy and emotions: Did you feel worn out?</td>
<td>0.607</td>
<td>0.368</td>
</tr>
<tr>
<td>Energy and emotions: Have you been a happy person?</td>
<td>-0.601</td>
<td>-0.103</td>
</tr>
<tr>
<td>Pain: How much bodily pain have you had during the past 4 weeks?</td>
<td>-0.585</td>
<td>-0.114</td>
</tr>
<tr>
<td>General health: I expect my health to get worse</td>
<td>0.571</td>
<td>0.037</td>
</tr>
<tr>
<td>Limitations of activities: Vigorous activities, such as running, lifting heavy objects, participating in strenuous sports</td>
<td>0.471</td>
<td>0.426</td>
</tr>
<tr>
<td>General health: I seem to get sick a little easier than other people</td>
<td>0.461</td>
<td>0.165</td>
</tr>
<tr>
<td>Limitations of activities: Walking several blocks</td>
<td>0.195</td>
<td>0.887</td>
</tr>
<tr>
<td>Limitations of activities: Climbing one flight of stairs</td>
<td>0.177</td>
<td>0.878</td>
</tr>
<tr>
<td>Limitations of activities: Walking more than a mile</td>
<td>0.267</td>
<td>0.828</td>
</tr>
<tr>
<td>Limitations of activities: Walking one block</td>
<td>0.123</td>
<td>0.823</td>
</tr>
<tr>
<td>Limitations of activities: Moderate activities, such as moving a table, pushing a vacuum cleaner, bowling, or playing golf</td>
<td>0.218</td>
<td>0.8</td>
</tr>
<tr>
<td>Limitations of activities: Climbing several flights of stairs</td>
<td>0.27</td>
<td>0.741</td>
</tr>
<tr>
<td>Limitations of activities: Lifting or carrying groceries</td>
<td>0.318</td>
<td>0.711</td>
</tr>
<tr>
<td>Limitations of activities: Bathing or dressing yourself</td>
<td>0.02</td>
<td>0.65</td>
</tr>
<tr>
<td>Limitations of activities: Bending, kneeling, or stooping</td>
<td>0.188</td>
<td>0.598</td>
</tr>
</tbody>
</table>

Three principle components are extracted and named as indicated. Following 3 times of repetition, the rotation converged.
cancer. Meanwhile, FACT and SF-36 are considered as more general HRQoL measures. Wei JT, et al. well described domain summary scores and subscale scores of EPIC. In particular, EPIC comprises 4 principle domains: urinary, bowel, sexual and hormonal, all of which are determinant factors in HRQoL of PCa survivors. Furthermore, subscale for each principle domain consists of function and bother. EPIC is now recognized as international and comprehensive long-term HRQoL measure for prostate cancer, and utilized in many clinical researches. Regarding FACT, numerous subscales for each disease-specific symptoms have been developed. SF-36 was designed based on Medical Outcome Study (MOS) conducted in the U.S in 1980s. SF-36 comprises 8 major domains: physical functioning, role-physical, bodily pain, general health problem, viability, social functioning, role-emotional and mental health.

In this study, we identified 4 components in EPIC, 3 components in FACT, and 2 components in SF-36 among Japanese PCa survivors. In line with our result, original study of SF-36 identified 2 components (physical and mental health) by PCA. Of note, although 2 factors identified in the original study were congruous with the previous study conducted in Japanese patients, the interesting difference was that bodily pain and vitality have more influence on mental status in Japanese patients than they have on Western patients. This result suggests that the cultural difference needs to be taken into account in the interpretation of the result. To the best of our knowledge, PCA of EPIC and FACT is yet to be conducted.

Our results would be quite beneficial to construct a single more concise and sensitive HRQoL measure in Japanese PCa survivors.

In conclusion, our study showed that based on HRQoL measures obtained from Japanese PCa survivors, EPIC, FACT and SF-36, PCA represent 9 distinct components of HRQoL. Our future assignment is to create an integrated and more feasible version of scoring system that comprehensively covers these 9 components, and to prove its validity in clinical settings.

Conflict of interests

The authors declare no conflict of interest associated with this manuscript.

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